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Locomotive Engineering

A Practical Journal of Railway Motive Power and Rolling Stock.

TECHNICAL INDEX TO VOLUME VIII. 1895.

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A Practical Journal of Railway Motive Power and Rolling Stock.

Locomotive Engineering

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"A HAPPY NEW YEAR
TO YOU AND YOURS."

A Few Object Lessons by Jim Skeevers —and One by His Wife.

Jim Skeevers made some reforms in the roundhouse, if he didn't find out whether or no he was an "official" or "one of the hands."

Skeevers' roundhouse is a big one, at a point where three divisions end—the north, the middle and the Granger branch. It's funny how some things about railroads get their names—the Granger "branch" is longer and runs more trains than the three main-line divisions put together.

When Skeevers took hold the "old man" told him that he'd like to see an improvement, but didn't expect it. Blithers was a good man, and it was a mean, low-down trick for the Midland to offer him more money for a smaller job.

Skeevers had never run into Granger regular and didn't know much about the roundhouse, but after looking around he made up his mind to one thing, and that was to clean up a little.

There were piles of scrap everywhere, worn-out air pumps and injectors, and lubricators were piled under the benches with old boots and discarded overclothes as companions.

A fringe of broken castings lined the battlements of the cinder dump, and between the roundhouse doors, facing the turn-table, the thoughtful and foresighted Blithers had for years stored up partly worn castings that "would come in handy some day for repairs."

Consternation reigned when "the new boss" ordered all this loaded on flat cars, and shipped all the scrap, good, bad and indifferent, to the main shop.

Brass scrap was hauled out from under benches and ruthlessly ordered away.

The old carpenter, who put in cab windows and repaired pilots, was put to work making cupboards "two feet wide and deep and seven feet high," one for each mechanic and helper in the house.

Skeevers ordered every man to put what he valued as personal belongings in that cupboard, and ordered the sweepers to gather up all the old shoes, and overclothes, and hats, and traps, and put them in the cinder cars—and to take everything not in the cupboards.

The traveling engineer—a fossil who kept his job by virtue of his age and a hold he had in a judgment for a broken leg—came down on Skeevers here and remonstrated. Skeevers called up the machinists one by one and asked them if they ever remembered repairing a broken-down engine with any parts off the select and sacred scrap piles between the doors.

None of them had.

"That's an object lesson for ye, Rory," said Skeevers. "Tons of that iron ought to have been melted up years ago; a little blacksmith work and bolt-cutter work will make lots of it useful, but I can't do it here with only ten men and seventy odd engines to keep going."

"Well, Skinny, I don't like them clothes coffins; they cost something, take up some room and make the men feel sort o' like they was in prison; no nachurel freedom——"

"A man that ain't clean enough to want to put his clothes in a clean box in a dirty shop ought to be in prison; the place used to look like a boar's nest around every bench," answered Skeevers.

Skeevers had clean cinders put between the turn-table tracks, and raked even and level, and the whole yard cleaned up in the same way, before "the old man" visited him.

"It looks nice, Skeevers," said he, "but it would cost fifty dollars a day to keep it so."

"A laborer at $1.10 a day will keep it clean, and sweep half the house beside. You see, sir, it's an object lesson in itself; it's clean and no one will think of throwing anything dirty there—why, if a pair of old overalls or a broken brake beam was thrown out there you couldn't see anything else; the men keep it clean because it is clean."

"Mebby that's so," said the old man, thoughtfully; if it don't cost no more than that you might try it for a while."

Skeevers "requisitioned" nine barrels of lime three straight months in succession to whitewash the shop, but it never came. When he spoke to the traveling engineer about it, Rory told him that the shop had been built eleven years and never needed whitewashing, and he reckoned the "old man" was right in refusing to go to the expense.

Skeevers bought a pailful of lime and painted a big white cross on the shop wall, right opposite the door. It stood out of the surrounding gloom like an honest man in Congress, and everybody noticed it and thought that Skeevers must be getting religious. Six weeks after, the general officers came down on a tour of inspection, and the general manager started when he saw the cross.

"What the devil is that?" was the pious remark he made.

"An object lesson," said Skeevers.

A light began to dawn in the mind of the general master mechanic, and he was half mad.

"Who's that object lesson intended for, sir?"

"Myself," said Skeevers. "I wanted to whitewash and couldn't get the lime, so I bought a quarter's worth and painted that to see if I could notice the difference."

"Why couldn't you get lime?" asked the G. M.

"I cut off the requisition," explained the G. M. M., "on account of expense—not the expense of the lime so much as the whitewashers."

"If you give me the lime I'll do the washing with a laborer and an air hose without a cent of extra expense."

Skeevers got his lime.

The Granger roundhouse was built with the promise of putting big shops there, but the company wasn't just ready yet, and they decided to use five stalls on one end of the big roundhouse as a back shop "temporarily." Alas! like all other "temporary" shops, it was destined to be the permanent one, and the "big shops" live and die in blueprints.

When they put up the partition on those five stalls, ten years ago, the general master mechanic decided to use a large stationary engine he had rebuilt after the car-shop fire at headquarters. It was one of those old, sleepy, plain slide-valve affairs with a 16-inch bore and a 36-inch stroke, with a fly-wheel 14 feet in diameter and weighing 9 tons. It occupied the place of one pit, took lots of room, used lots of steam and made 21 strokes per minute.

Every tool and every man in the place worked in perfect unison with the moving power.

The big boiler house—to be—was planned to stand where the cinder pile was now, and being yet in the blueprint stage they put up a good, 50-inch shell, upright boiler in a corner of the shop to furnish steam for the Jonah that stood in the center.

The "shop" consisted of the big engine, four pits, three lathes, a shaper, a drill press, a wheel lathe and a grindstone, and Skeevers figured that under proper conditions the big engine could run forty-six shops like that and never sweat a hair.

He walked through this place daily for four months noting the peaceful effect it had on everything; the men talked slow and walked slow and worked slower; his own pulse dropped the minute the door was shut on the rushing sound of blowing-off steam in the roundhouse, and he felt drowsy and dreamy and lazy—but Skeevers was thinking.

Out in the yard stood an abandoned steam shovel that had been in a wreck; Skeevers surveyed her, and rescued a little engine from her interior, and had it taken to the shop.

This little engine only had a 7 x 10 cylinder, but it had an amazing hustle between the governor and the piston somewhere. Skeevers set it up near the boiler and piped it up one Sunday. The men thought he was going to use it to pump water into the boiler.

Skeevers figured on its speed and got a big pulley for the main shaft. He put on the belt Saturday noon and, lo! the little engine carried the work just as easily as if designed for the place; but her little piston was hopping back and forth in the cylinder two hundred and sixty-one hops a minute.

Sunday, Skeevers had a gang of men there. They skidded the old engine out back of the shop, tore up her foundation and put rails back on the much-needed pit.

From that day on there was a perceptible improvement in the time and motion of that shop.

Last Tuesday week, the general officers were again on their rounds. The G. M. had admired the clean walls of the house for the hundredth time, approved of the new doors with the big windows, said the moving of the smoke jacks, so as to "head" the engines in, was an inspiration, and many other compliments, when he suddenly turned to Skeevers and asked:

"Any more of them object lessons around handy?"

"Well, yes," said Skeevers, "come out in the shop."

When they went in, a fifth engine was on blocks getting her tires turned. The little monitor near the boiler tapped a quick waltz time; the boiler-maker, in a firebox, was trying to keep up the stroke—and was a little behind. Every tool was on a higher feed than it had ever known; the men stepped quickly. Dave Turner was putting a lathe dog on another piece of work, so as to clap it right into his machine, and save time after the present cut. A man outside was washing windows with a swipe of his long brush that indicated that he didn't intend to make a winter's job of it. In fact things seemed to hum.

"Well, I'm damned," said the pious G. M., "this here is an object lesson. Say, Mr. Skeevers, how do you account for this 'git-up-and-git' here—you've got the same men and the same tools?"

"Yes, sir, but another prime mover. The way I figure it is this—a man cannot be much better than his surroundings. Give a machinist a nice new lathe in a dirty, foul, dark shop, and the angel of death couldn't make that man keep that tool clean long—in a clean shop he wouldn't think of letting it get dirty. It's the same way with engineers. Give the best engineer in the land a dirty, rickety, badly cared for engine, and you will soon have a dirty, rickety, careless engineer and dirty, rickety, careless work. Herd men with swine and they will soon become hogs. On the other hand, surround men with comforts, cleanliness and order and their service becomes like their surroundings and their lives like their work. Order and cleanliness save time and money, for it is easier and quicker to do a thing right than to do it wrong. That more work can be done is proven right here. We rebuilt the last five engines in just one day more than it formerly took to rebuild four, and this five will be gotten out in the same time. I have never said a word to a man, either; I just gave 'em an object lesson with that engine and the whitewash."

"There's one object lesson we've overlooked ourselves, John," said the G. M. turning to the G. M. M., "and that is Mr. Skeever's ability. Now, if I was general master mechanic of this road and couldn't find any other way to move the corpse you have in charge of the main shop, why, I'd promote him and slam in a—well, say, an object lesson."

Saturday there was a bulletin notice that James Skeevers was hereby appointed general foreman of the entire road, *vice* Amos Slocum, promoted.

Skeevers took the notice home and showed it to his wife.

"Sairry," said he, proudly, "there's an object lesson for you—shows what a little git-up-and-git will do for a man."

Sarah read it through carefully, looked up to Skinney through those cool gray eyes of hers and said: "James Skeevers, you're the dearest old fool on the whole road; can't you see an object lesson *in advance?* Don't you know that John Masey was a no-good mechanic, and that he got to be general master mechanic by accident, and that he's a twenty-two caliber—a little scant—and jealous of every man under him that shows ability above his own? Don't you see that the general manager has forced his hand in this matter, and can't you understand that when he gets you into the big shop that he'll make things very interestin' for you? Why, James Skeevers, he'll have your hide hung on the shop wall as an example of a man who knew too much! You mark my words!"

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What It Is For.
What It Does.
How It Does It.

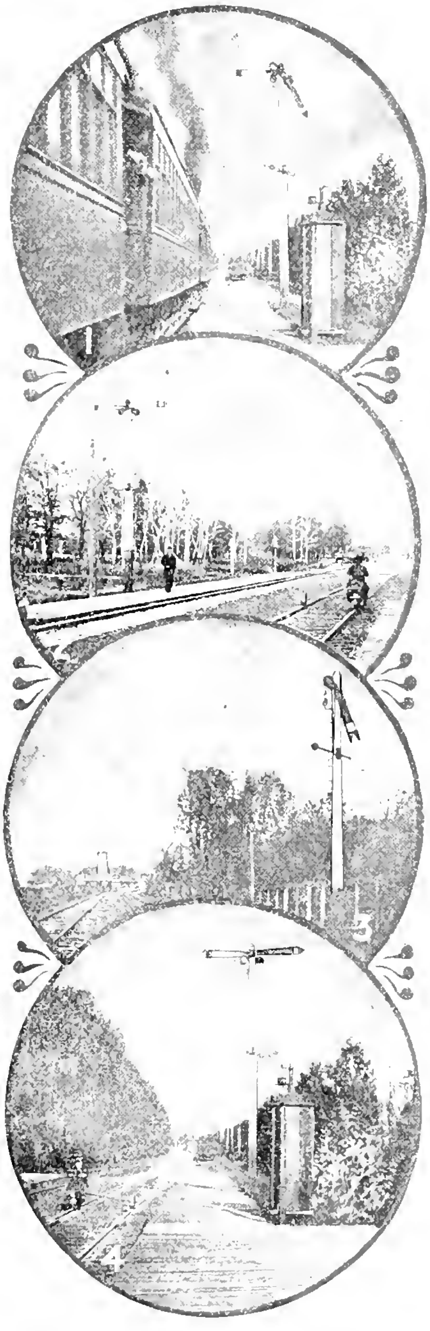
By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

"What are we stopping for, conductor, out here in the woods? This is a limited train. What! stopped by a signal, a block signal, you say? Why, what is that? Oh, I see! You have a red blade projecting from the top of a pole, so that when the blade is moved up and down from the tower by the signalman it indicates to the engineer whether he may enter the block or not, the block being the piece of track extending to the next signal. So, when we are stopped by such a signal it means that another train is in the block, and we will have to wait until it passes out of it."

And thus it is that to-day trains are being run through towns and cities, over mountains and prairie, through bridges and tunnels, in cuts and around curves with absolute safety, a fact not fully appreciated by the traveling public, but which becomes to the engineer, whose responsibility is lightened and from whom anxiety is removed, a guiding star, telling him that the track is his and that there shall be no one to dispute it with him, for such little arguments, you know, are sometimes disastrous.

Block signaling, though limited in extent in this country, in proportion to the miles of track operated, is so rapidly being extended, not only from the natural increase of business and consequent demands for a safe method of operation, but from the general knowledge being acquired of the advantages to be gained from such a system, that I believe an article on the subject would be both interesting and instructive. To the man well posted on signal matters, little that is new will be found, as the article is written more for those who are constantly guided by a signal but have little idea of its construction.

The commencement of signaling may be said to begin with the use of the locomotive, for it soon became manifest that something would have to be devised, not only to prevent collisions between trains, but to give information to engineers regarding the position of switches and the right to go ahead. Many forms and devices were used in these early days, few of them being seen to-day, but which, as in the development of the locomotive, became stepping-stones to things much better.



1. Home Block Signal—"All Clear."
2. Home Block Signal—"Danger, Stop."
3. Distance Block Signal—"All Clear."
4. Home Block Signal—"Danger."

As each engineer preferred his own devices to those of others, it followed, as a matter of course, that the practice was very varied, so much so in some cases that the safety signal on one road became the danger signal of another. Naturally enough, this state of things brought about many serious accidents, and finally resulted in a meeting being held by those interested, for the adoption of a standard form of fixed signal to be used by all the roads. The choice fell upon the "semaphore," a signal designed by Mr. Gregory in 1841, which indicates—by position and not by its form—whether the track is clear and the train has a right to go ahead.

It was decided that a horizontal position of the blade should indicate "danger" or "stop;" a vertical position, "all clear" or "go ahead," and a position midway between these two, making an angle of forty-five degrees with the horizontal, "caution" or "proceed carefully."

Its construction was very much the same as that used to-day, consisting of a blade pivoted at the top of a pole and capable of being turned through about a quarter of a circle. The colored glasses for giving the night indications were carried in a separate frame pivoted lower down on the pole, instead of being held, as in modern practice, by the casting to which the blade is fastened. The blades for governing train movements in one direction were always put on the same side of the pole. In this country, the blade projecting on the right-hand side of the signal pole, as looked at from an approaching train, is the one that governs. In England, where all trains run on the left-hand track, signal blades projecting to the left side govern.

The signals were operated under what we call the "time interval;" that is, not allowing one train to follow another into the block until the lapse of a certain period of time. When a train entered the block the signal was put at danger and kept there for five minutes, when it was pulled to a cautionary position, and after the lapse of five minutes more the signal was "cleared," giving the right to the next train to proceed.

Experience with this method of operation soon demonstrated that the principle was not correct. For while a train may

have passed, a certain length of time, the signal gave no indication of how far it had gone. The many accidents occurring under this system stimulated the invention and adoption of electric indicators and telegraph instruments as a means of communication between signalmen, thus making it possible to keep a space interval between trains, not allowing a second train to enter a block while it is occupied by the first. This method of blocking, keeping a space interval between trains, is the end to which all the modern systems of signaling are designed, although the methods by which this result is obtained vary considerably.

The next important principle to be developed was that the normal position of a signal should be at *danger*, not at safety; or, in other words, assuming that danger existed unless known to the contrary. With a signal constructed as were those first used, so that on an accident happening to the apparatus, or in case of any of its parts becoming disconnected, it would at once fall to the "all clear" position, no protection would be afforded a train in the block. Any engineer, of course, not knowing that the signal was out of order, would take the indication as one intended for him and proceed accordingly, a result very likely to cause trouble, but for which he could not be blamed.

With the signal always remaining in the danger position, and being so constructed that any accident or breakage of the apparatus would cause it to assume the danger position, no accidents can happen, as trains would be stopped instead of being allowed to proceed.

In the most approved systems, the signal automatically returns to the danger position immediately upon a train entering the block, thus making it impossible for a second train to enter, as might easily occur—under the old system—should the signalman fail to return the signal to the danger position.

As showing the commencement of block signaling in this country, the exhibit of the Pennsylvania Railroad at the World's Fair, of a pole and ball signal used on the Newcastle & Frenchtown Railroad in 1832, is very interesting, the following information being obtained from a letter written by Mr. A. Feldpauche, principal assistant engineer of the P., W. & B. Ry., in regard to its use. The road was about 20 miles long, and the signals seem rather to have been used for conveying information from one end of the line to the other than for that of a block.

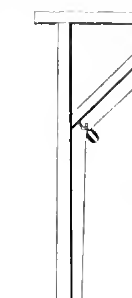
"When the train was just starting from Newcastle, the man in charge of the signal at that point raised the ball to the top of the pole. The man at the next station, seeing the white ball raised by the first man, raised his ball to half the height of his pole. The men at the other stations, each on the lookout with his telescope, which, you will see in the cut, were placed in the guides provided for the purpose on the side of the pole, also raised their balls to half mast, thus conveying the information throughout the line that the train had started.

"When the train reached the first station, the man would immediately raise his ball to the top of the pole, as a signal both ways that the train had reached him, lowering his ball when the train reached the next man ahead, this being repeated successively at each of the four stations.

"When a train, having passed one station, did not arrive at the next, or was seen to be in trouble in any way, the man at the station next nearer Newcastle would lower his white ball and substitute therefor a black ball, kept at hand for the purpose, and would raise it to the top of his pole as a signal to be successively transmitted to Newcastle, whence a relief train would be dispatched to the assistance of the regular train."

Block signaling may be said to be practiced in this country in two ways—that of "absolute" blocking, in which one train only is allowed to occupy a given block, and "permissive" blocking, where, under certain regulations, more than one train is allowed to enter.

From the definition of a block—"a section of a track between two signal stations, the use of which is controlled by fixed signals"—it is seen that where absolute blocking is maintained, both head and rear-end collisions are impossible, and were it not for the expense and occasional delay to traffic, such would be more generally practiced. It is a fact, which experience is demonstrating every day, that more trains can be run over a given piece of track and with more safety by a properly arranged block system than by any code of rules that can be devised, and although one cannot show in figures how much can be saved to a road by immunity from accidents, it will certainly repay any investments made in apparatus and operators' wages.



More particularly is the problem of block signaling increasing in importance as the traffic on many roads is becoming too dense to be handled without such a system. Managers who thought that the results obtained by the English with absolute blocking could be ignored on account of the different conditions of operation in this country, are gradually finding it to be the only safe way to operate their roads.

In point of fact the means are already at hand, and any road having a telegraph wire and operators can, at a moment's notice, put the absolute blocking of all trains into effect, should conditions arise under which it would be desirable to do so. That many roads do not take advantage of this and train their operators is much to be regretted. It is to be hoped that with the spread of information regarding the working of block systems and the safety to be gained by their use, managers will come to a full appreciation of their merits.

With roads using a block system, where, from considerations of expense, the blocks are of a greater length than is advisable, "permissive" blocking has, with *certain restrictions*, come very much into use. Although it is an abandonment of the "space" for that of a time interval, the results obtained are such as to make its use in many cases a matter of good business judgment.

Before describing the different methods of operating block signals, it will be well to describe the construction of a semaphore signal and to discuss the interesting questions connected therewith.

As will be seen in the sketch, a casting is pivoted at the top of a pole which holds the blade and also the glass; this casting is called the arm plate. The blade is a thin board 5 feet long, tapering from 7 inches in width where bolted to the casting to 10 inches at its outer end. The end of the blade is often pointed, to more easily distinguish the block signal from other semaphore signals. The height of the pole, ordinarily, is about 25 feet above the ground, and a ladder bolted to its side allows of easy access to all the parts.

About midway of the pole is an iron lever called the balance lever, to which are attached the wires for operating the signal. An up-and-down rod connects this lever with the arm plate casting, being attached to the casting on the opposite end from the blade.

By putting a weight on the balance lever, it is seen that the blade will be greatly overbalanced, and will, of course, be held in the horizontal position until a force is exerted on the lever sufficient to lift this weight and lower the blade. This construction fulfills the requirement that the "normal position of the signal should be at danger," as it calls for a direct effort on the part of the signalman to change the signal to "all clear" position.

To give the different indications at night, a lamp is so placed that the light, when the signal is at danger, will show through a colored glass held in the arm plate casting, and will show an unobscured white light when "all clear." While the signals for use in day-time were going through the various changes from one of "form" to that of "position," those for use at night simply became a question of color, as nothing has as yet been found which compares with it in distinctness and simplicity. This question of the proper color to be used for the different night signals is one of great interest to all railroad men, and one which is being widely discussed.

What engineer has not had to pass an examination for color blindness, or has not

felt somewhat "wrathy" when a sleepy operator has allowed his signal lamp to get low or go out?

Who has not felt his pulse quicken when, on some dark night, a red light has suddenly appeared on the track ahead, even though it should prove to be only a "wide-awake" drummer anxious to get out of town, and who has stopped the train by putting a match inside of a red bottle?

Red is used for the danger or stop signal everywhere, as it makes the greatest impression on the sense of sight. White is used for the "all clear" and green for the "caution" signal on most roads in this country, although a few follow the English practice of using green for the "all clear," white not being used for any signal. The use of white to indicate "all clear" and green for "caution," at first sight appears to answer all the requirements; but so strong are the arguments against this arrangement, that if a more satisfactory color could be found for the cautionary signal, green would be universally used for the "all clear" signal and the use of white abandoned.

These arguments are, first, that the glass fastened in the arm plate casting may break and show a white light when the signal stands at danger.

Second, engineers may mistake a light in some street or dwelling for the signal light and run by it.

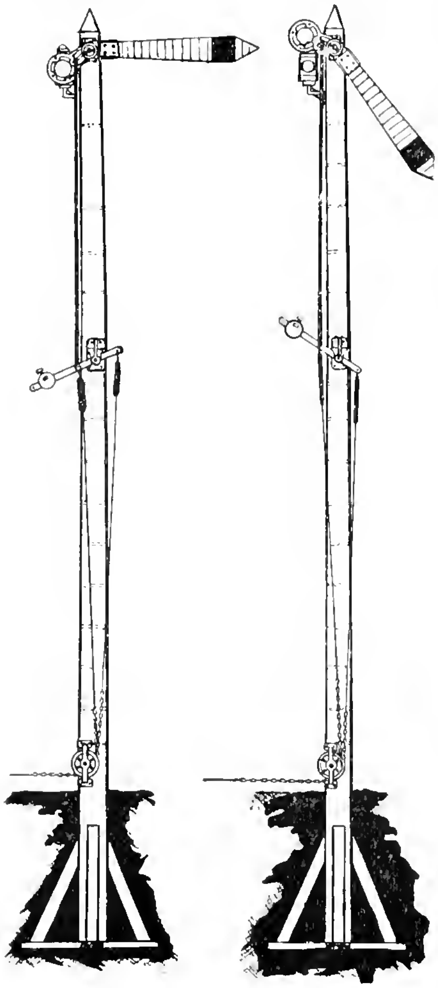
Few accidents have happened from the glasses breaking, but the possibilities of a serious collision are always present. For this reason stationmen should always "keep an eye" on the signal to see that the glass is in its place, and engineers should, whenever possible, see that the position of the blade corresponds with the indication given by the lamp.

The use of green for the all clear signal overcomes both objections against white, but leaves no available color for a cautionary signal. The practice on one road using green for the "all clear" is to show both a red and a green light for the caution signal, blotting out the red for "all clear." On another road three lights are used, two showing in a horizontal line to indicate "caution," and two in a vertical line for "all clear."

The color the blade is painted has nothing to do with the indications given, for while the blade may change its position the color does not, and consequently only one indication could be made. The blade is painted red for distinctness, that being the most easily discernible color; but on this point opinions differ, as one very prominent road paints them yellow. It may be well to note here that there is one system of blocking, "an automatic electric," in which the different indications are made by a change of color, or rather the appearance of a red disc for "danger" and its absence, thereby showing a white background, safety.

The next to be considered (having seen how a signal is constructed) are the different signals to be found at a block station, with the meaning each is intended to convey; not that all are to be found at every station, but that we may better understand how a good block signal system is operated.

At first the only signals used were those at the entrance of a block, these, for economical reasons, being put at stations or at points where switch tenders were already stationed. As traffic increased and the speed of trains became greater, it often happened when the signal was at danger that trains would run by, owing to the location of signal, or to the condition of



the weather being such as to prevent engineers from seeing the signal soon enough to stop. The result of this was that engineers were forced to slacken speed and approach the signal very carefully, so that if found at danger they could stop before passing it.

To make this unnecessary, a second signal was erected which would give the same indication as the first signal gave, being erected a distance down the track from which the train was approaching. The engineer was, by this arrangement, informed of the position the controlling signal would be found in, some time before reaching it.

For the sake of distinction, the first signal—that is, the one controlling the block—is called the "home" signal, and the second, or caution signal, the "distant" signal, these being the names by which they are known to-day. The possibility of operating the distant signal from the same place as the home signal, strange as it may seem to us now, was not thought of for some time. The distant signal was placed only so far down the track as it was possible for a man to run, after first putting the home signal in the clear position, before the arrival of the train.

A bright switchman, anxious to save himself the trouble of so much running, was the first to think of connecting this distant signal by means of a wire to a lever in the tower in which he was stationed. That this should have escaped the engineers and have been thought of by a switchman, recalls the invention of the valve motion by the lad who, getting tired of working by hand the steam engine valve, attached it to the end of the engine shaft by a stick.

Both signals were originally of the same form, but owing to the necessity of making a distinction of some kind between them, a notch was cut in the end of the distant signal. To make a still further difference, the distant signal blade was painted green—a color which expresses the character of the indication given by the signal.

A very amusing anecdote is told by Mr. W. J. Williams, traffic superintendent of the Brighton Railway, England, of the origin of the notch. Thinking that a distant or caution signal should be different from a home or stop signal, he sent a workman to a station on the main line between London and Brighton to cut a notch out of the end of the distant signal blade. The Brighton tracks are at this point used by the Southeastern Railway Co., and two or three days after the notch had been cut he received an indignant letter from that company, asking why he allowed his signals to get into such a state of disrepair that large pieces were actually chipped out of the end of them.

Soon after the distant signal came into use, the cautionary indication, as given by the home signal blade, became, to a great extent, discontinued, owing to engineers not properly observing it. For a "cautionary indication" is really permissive blocking, a time interval between trains, and, unless great care is used by the engineer, accidents are very likely to happen.

Another fact that made its use objectionable was the difficulty of keeping the signal properly adjusted, for, unless it was always lowered to the same position, engineers would be in doubt as to the exact meaning intended. If the safe side were not taken, serious consequences were likely to follow.

Where permissive blocking is used the best systems do away with the inclined position, and either stop the train to give a "permissive card" or else use two signals on the same pole, the upper one being used for the "danger" or stop signal and

the lower for the permissive or cautionary indication. This arrangement consists in placing a permissive arm, painted green and notched on the end, or a green light at night on the pole below the block arm and to work in connection with it.

The indications as given by these two blades on one pole are plain and unmistakeable, and are as follows:

Block and permissive arms *horizontal*, or upper light *red* and lower light *green*, signifies "Danger, stop!"

Block arm *vertical* and permissive arm *horizontal*, or upper and lower light *white*, signifies "All clear, go ahead!"

It is here that I wish to call attention to the two ways that caution signals may be read, for unless clearly understood, the indications as given by each signal will not be correctly interpreted. Not that the indication for "caution" does not mean to exercise due vigilance and care in either case, but that the extent to which caution is to be observed varies greatly.

One indication for caution is given by the signal blade in the inclined position, or when the lower arm of a two-blade signal is in the horizontal position, the upper one being vertical; the other is that given by a distant signal when at danger, indicating the position in which the home signal will be found. The one is permissive blocking, pure and simple; the other a warning to the engineer to use caution in approaching the home signal, expecting to find it at danger.

The two signals at a block station, the home and the distant, were for a long time all that were necessary to properly handle trains without causing serious delays. But with the congestion of traffic as found on many roads, these have proved deficient, and a third signal has been added, thereby increasing the number of trains it is possible to run over a division in a given time.

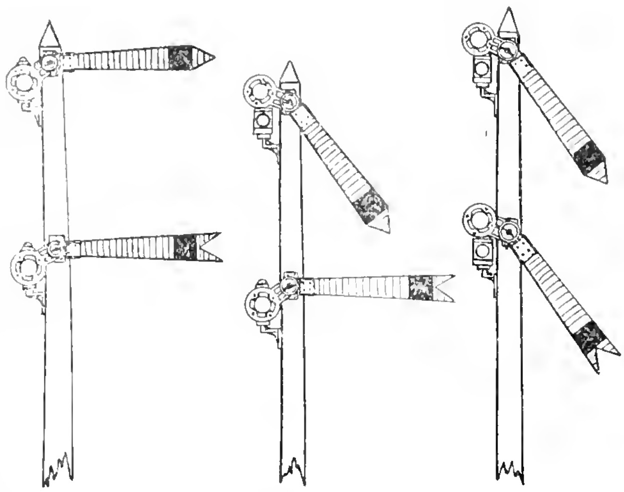
The third signal is aptly named the "advance" signal, from the position in which it is placed, being put far enough in advance of the home signal to allow a train to clear the latter at least 300 feet before being brought to a stop.

The indications of the *advance* signal being positive, the same as those of the *home* signal—the *horizontal* position of the blade meaning "Danger, stop!" a *vertical* or inclined position, "All clear, go ahead!"—there is no chance for an engineer to mistake or fail to observe them.

Without this signal it was often found that trains working at stations delayed following trains, from the fact that not having passed the home signal the block was not clear, and until it was the other train had to wait. With the use of the advance signal it was possible to so locate the home signal as to make a short block of the track between these two signals. By making this short block include the station and side tracks where switching was done, a train standing at the station would have cleared the block just behind it and at the same time remain under the control of the signalman.

The location of the home and advance signals at any station is pretty well defined by the character and amount of the business transacted. That of the distant signal, however, is one that will vary with each locality and calls for the exercise of care and good judgment, for on the position in which it is placed, more than with any other signal, will its usefulness depend. As the signal is intended to repeat the indications of the home signal, it is necessary that the signal be placed at such a distance as to enable a train after passing it to stop before reaching the home signal, no matter what the conditions are.

Common practice in this respect is to put the distant signal 1,200 feet from the home signal, unless the conditions are such



as, from the speed of the trains, or on account of grades and curves, it cannot be seen. There is a limitation to the distance it is possible to operate such a signal mechanically, owing to the difficulty of properly caring for the expansion of the wire and also the power required to "clear" the signal. The lever for this signal must also be interlocked with those of the home and advance signals, so that the signal cannot be pulled to "all clear" until they have both been cleared, thereby making it impossible for the signalman to make a mistake. Being placed at a distance from the home signal and the first seen by the engineer, it has become, in practice, the governing signal, allowing trains to keep a uniform speed under all conditions of operation. The number of signal poles in use at any station or tower varies, of course, with the system used, from that where two signals for trains running in opposite directions are carried on one pole, to where six poles are used, each signal being in the best position with reference to the track which it governs.

Before taking up the different methods of operating block signals, it is perhaps advisable to call attention to the principal points which have just been considered, and which it would be well to bear in mind.

"Absolute blocking," or the maintenance of a "space" interval between all trains, is the only sure method of preventing collisions.

The indications of a semaphore signal are made by the position of the arm, and not by its form or color.

The normal position of all signals must be at *danger*.

A semaphore arm displayed to the right of the signal pole, as seen from an approaching train, governs.

A *horizontal* position of the semaphore arm, or a red light at night, means "Danger, stop!"

A *horizontal* position of a semaphore arm that is notched in the end, or a green light at night, means "Caution, go slow!"

A *vertical* position, or one nearly so, of a semaphore arm, or a white light at night, means "All clear, go ahead!"

A *block* is a section of track between two signal stations, the use of which is controlled by fixed signals.

A *home block signal* is a fixed signal at the entrance of a block to control trains entering said block.

A *distant block signal* is a fixed signal of special form used in connection with the home block signal, and placed at such a distance as will enable all trains to stop between the distant signal and the home signal.

An *advance block signal* is an auxiliary fixed signal, placed in advance of a home block signal to control trains that have entered the block.

New Way of Making Distinctions in Class of Passengers.

Yorkshire men are reputed by other Englishmen to be dolefully slow, but sure as a hydraulic ram. They are also noted for being ingenious, when they have plenty of time to think out anything difficult of solution. Some genius of that country lately discovered how to have three classes in one omnibus, with the seats all of the same kind. An American traveler reports the discovery. He entered the 'bus, and was mystified to find that they carried first, second and third classes. He sat cogitating over the problem, inclining to the opinion that the classes were arranged on the apparent ability of the different passengers to pay high fare. But midway on the journey they came to the foot of a long, steep hill, and the guard shouted: "First-class passengers, keep your seats. Second-class passengers, please peg out and walk. Third-class passengers, get out and push."

The Caledonian Railway Shops

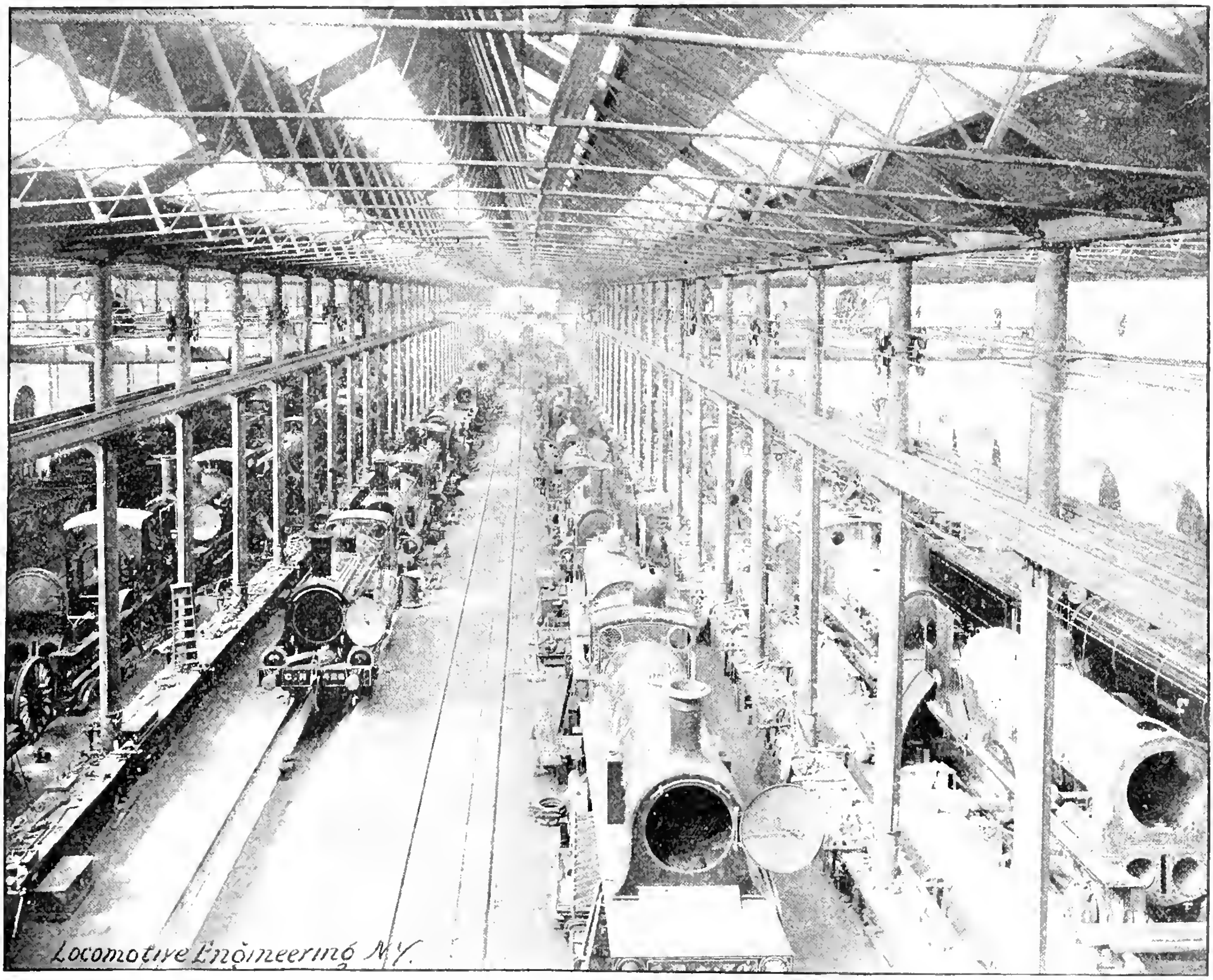
[EDITORIAL CORRESPONDENCE.]

When an American railroad man of engineering connections mentions that he is going to Europe and that he wishes to visit the best railway repair shops, he is generally told that the most important and interesting establishment of the kind to be seen abroad is the London & Northwestern Railway Works, at Crewe, England. I should say, also, by all means go and see the works at Crewe; but I am far from believing that they are the most interesting railway shops to be seen in Europe. I believe they are the largest of the kind to be found anywhere, but magnitude in itself does not constitute a great attraction. My opinion is that the Lancashire & Yorkshire Railway shops at Horwich, England, and the Caledonian Railway shops at St. Rollox, Glasgow, are the most interesting and best arranged works to be seen abroad.

The latter works were founded some fifty years ago, when the place where they stand was a small country hamlet outside of Glasgow. The city now extends in solid streets far beyond the works. The shops had a history, like many other establishments built for existing needs. They were originally designed to do the repair work for about fifty locomotives with the required equipment of cars. The works have now to keep in repair 828 locomotives, 2,000 carriages, and 53,000 wagons, as the freight cars are called. Besides that, the works build all new equipment and perform a great deal of manufacturing for other departments besides that of rolling stock. When additions to the old works became too confusing and expensive, the company determined to build entirely new shops on the best designs, and they carried out this purpose in a way to excite admiration.

A variety of views of the shops are presented with this article. The works, as a whole, form a slightly broken square, with a wing projected along from one corner. A long strip of the square is divided off, and is occupied by the forgesmith's shop and boiler shop. The wing contains the iron and brass foundries, pattern shop and part of the boiler shop. Entering the end of the main building, we find a small "bay" devoted to tinsmith, coppersmith and dressing shop; then, in succession, we pass through erecting, machine, wheel, wagon and carriage shops; then the sawmill, as our planing mill is called. The various shops and departments are subdivisions of one huge building, which covers about twelve acres.

The whole of the main building is covered by a series of iron truss roofs, supported by iron pillars. Each roof spans 40 feet, and each longitudinal space between the pillars is called a "bay." The appearance of the various shops can be well understood from the engravings, made direct from photographs which were furnished by Mr. John F. McIntosh, assistant to the locomotive superintendent. The erecting shop has accommodation for 100 locomotives. All the shops are remarkably well provided with tools of all kinds, the cranes and appliances for handling material being quite conspicuous. The large crane in the erecting shop has a capacity of 30 long tons, and is used in moving the engines, lifting them bodily, and for transporting all kinds of heavy articles.



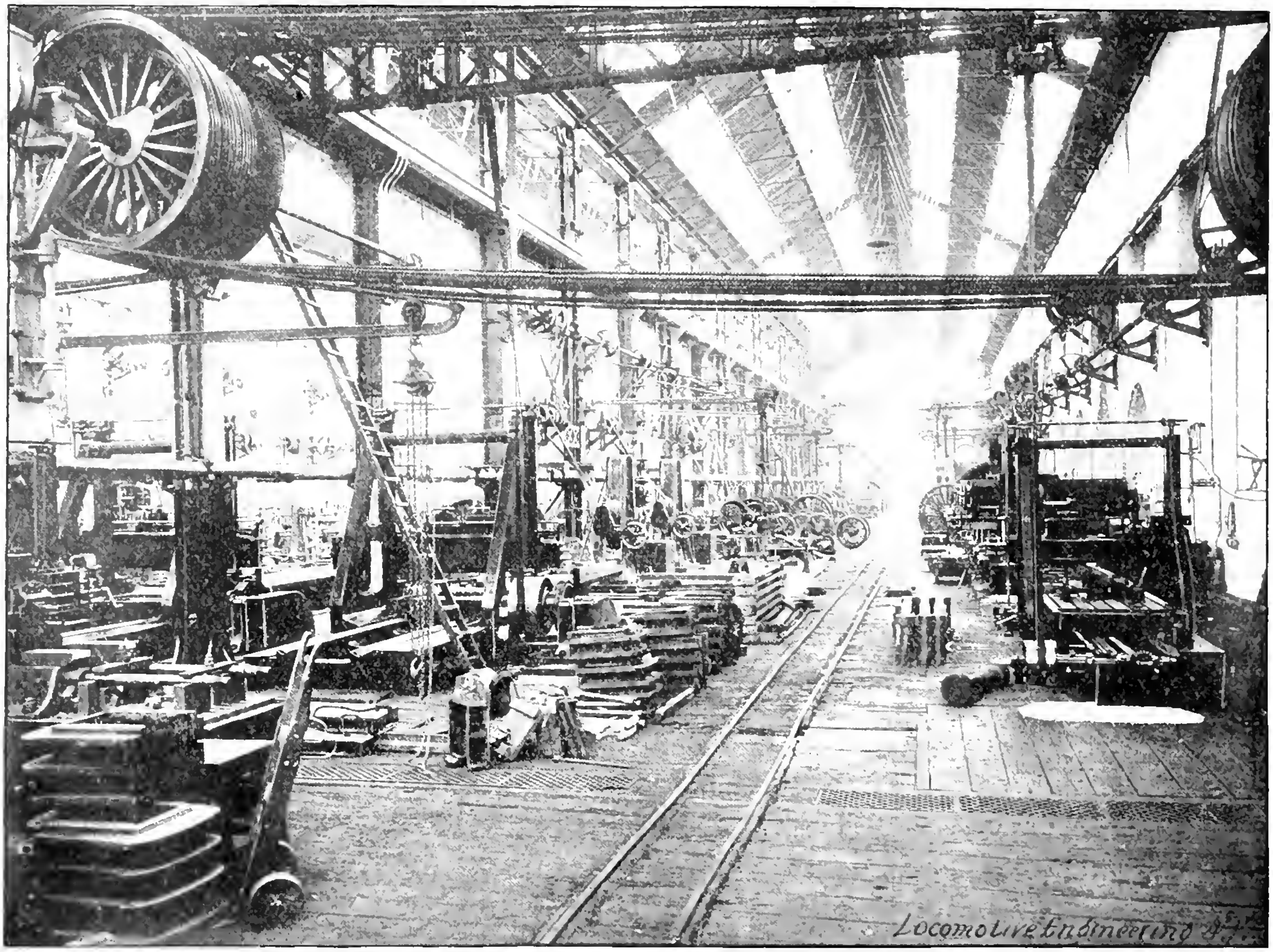
CALEDONIAN RAILWAY SHOPS. ERECTING SHOP, FROM BRIDGE OF TRAVELING CRANE.

The work turned out is all supposed to be interchangeable, and the probability is that it is as nearly so as most machine shop productions, but they are not nearly so well provided with jigs, formers and exact rigid templets as our first-class shops are. They have excellent heavy machine tools, but the small tools, such as turret lathes, milling machines, etc., which we employ to produce so many articles perfectly finished, are not well represented in any shop abroad which I have seen. A tool used here to good advantage is a Whitworth planer which cuts in both directions. It has been very little used in America, and probably few of our readers have seen one at work. At the end of each stroke it reverses the cutting tool, which keeps on with the cut. It is only adapted for plane surfaces, but it is particularly useful for planing slab frames and such work.

There are 2,430 men employed in the works. Mechanics receive from $6 to $8.50 a week, while laborers receive about $4.50. A great deal of interest in the welfare of the employés is manifested by the management. An excellently managed benefit society is maintained by the workmen, the company giving them valuable assistance in its operation. There is a dining room within the works where the men are given meals at actual cost, the company supplying accommodations, light and heat free of charge. The relations between the company and the employés are of the most cordial character.

During my various visits to the works I was treated with great kindness by Mr. Lambie, the locomotive superintendent, and by Mr. McIntosh, his assistant, who was a fellow driver of mine on the northern part of the system years ago.

A. S.



CALEDONIAN RAILWAY SHOPS. THE MACHINE ROOM.

The One Essential Rule in Locating Engineers' Valves.

Builders and designers of locomotives are prone to get things unhandy for the men that run the result of their works, but there is a vast improvement in this line in the past five years. The greatest source of complaint is generally the location of the engineer's valve. This is often hard to locate in a place easy to handle; but we often notice the valve in exactly the right place in the cab, but still hard to manipulate easily and with the best results. There is one foundation rule that should never be forgotten, and that is: "Put the valve up so that the engineer *pulls* the handle toward him to apply the brakes." If a man can run his four fingers over the valve handle at right angles to it, when the valve is in running position, he will place his thumb on the valve body to steady his hand when doing nice work in service applications. This rule holds good in any style of valve, from the old three-way cock to the D-5. It don't cost any more to put them up right than wrong. One is a source of comfort to one man during the life of the engine; the other is like a ringworm—when it don't actually hurt it annoys you to see it.

The English Admire the Strength of American Cars.

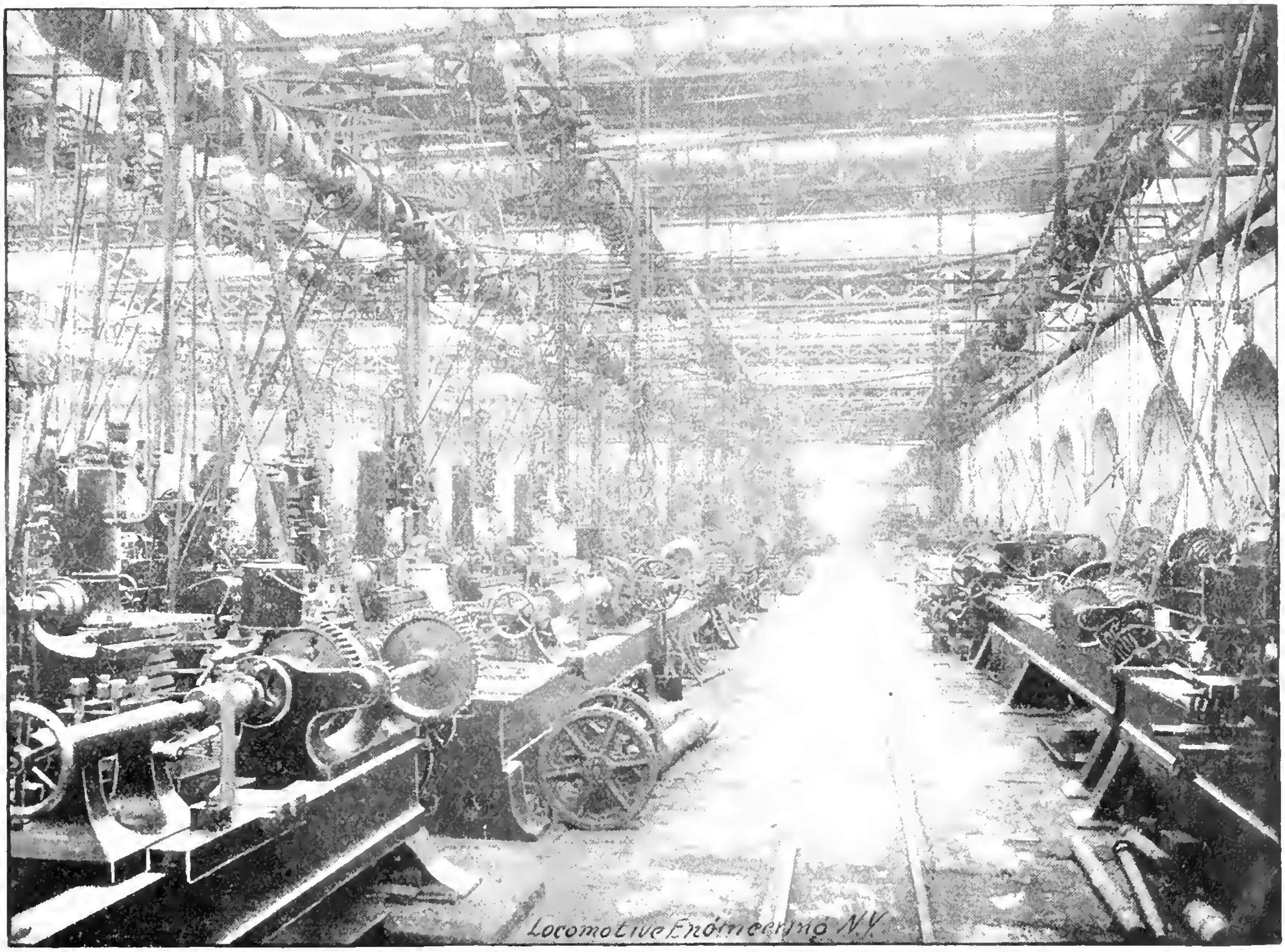
The merits of the American style of passenger car, as a form that will withstand severe battering without going to pieces and crushing the lives out of the occupants, are steadily forcing themselves upon the British traveling public. For the last month or two the English engineering papers have commented very fully about an accident which happened at Northallerton, in Yorkshire, where a fast passenger train came in collision with a freight train when running at very high speed, and no passenger was killed. This was principally due to the strength of a Pullman car which received the greater

part of the shock and came out little the worse.

The *Railway World*, of London, commenting on this accident, says that the Pullman car came out in a comparatively uninjured condition. Although shifted from its normal condition on the trucks, says our contemporary, the car body suffered little and resisted the shock to a remarkable degree.

It is doubtless true that the weaker carriages before and behind the Pullman car acted in some measure, at least, as buffers; but it is evident that if opportunity of escape, than the matchbox structures which compose many of our express trains.

The accident at Thirsk also demonstrated the advantages of the Pullman car in case of collision; and while accidents are happily of rare occurrence on English railways, it is a question that managers and superintendents of car departments might well consider, whether some changes cannot be made which will approximate in some degree the strength and stability of the Pullman car.



Caledonian Railway Shops. The Turning Room.

the other cars had been built with something of the longitudinal stiffness of the Pullman, while the train might have been thrown off the track, there would have been no such complete smashing up of carriages.

Our ordinary carriages, with their comparatively weak sills and end construction, serve quite well enough for regular service, but in case of collision they can offer slight resistance. With cars of longer and heavier build, the alignment of the train may be broken, and the cars may be thrown violently from the line and overturned, but the bodies are more likely to remain intact and to offer the occupants an

Watch Foreign Patent Swindlers.

Persons who obtain patents in this country have long been familiar with the assaults of patent selling agents, who try to obtain money from the patentees on all sorts of pretexts, principally based on the ability of the applicants to sell the patents.

Of late there has been a troublesome addition to this class of harpies in the shape of reputed agencies established in London, which pretend to have facilities for securing and selling patents in England. The United States postal authorities have recently given notice that the International Patentees' Agency of London is a fraud. The following account has been given of the operations of this "agency":

"These parties advertise that they will have inventions patented by the United States patented by the English Government also, and they address circulars to patentees in this country to that effect. They say in their circulars that they are annual subscribers to the *Official Gazette* published by this Government, containing lists of patents granted, and that this *Gazette* is usually in their possession a month or six weeks before the specifications of the patents are published at the Patent Office in London, and that this short space of time prior to the official publication is really the only opportunity the patentees have in which to obtain valid British patents.

"These circulars, which are sent to patentees, state also that the *Official Gazette* gives the agency all the information in regard to the inventions that is required to obtain provisional protection for nine months, during which period a four years' patent may be obtained.

"They also state in their circular that the Government fees are $15 for a provisional protection for nine months and $42 for four years, and that the parties may re-

mit $15 and get a provisional protection, or $42 and receive a four years' patent at the outset, as they prefer. The only compensation they ask is that they 'retain the sole right of the sale of the invention, when patented, for three months.'

"Many American citizens bit at this bait, with the result that they have not heard from their money nor the agency since their remittances."

There are several reliable parties in London who are prepared to negotiate for the sale of American patents. Any patentee wishing to reach them should do so through some reputable patent attorney or good business house. If he does that, he need not be afraid of falling into a nest of thieves.

Improving a Shop Press for Rod Brass and Driving-Box Work.

General Foreman Bleesdale, of the Detroit, Grand Haven & Milwaukee road, Detroit shops, recently built an air press with cylinder 20 x 20 inches for forcing in driving-box brasses and rod bushings.

He found that the press was too quick in moving with air, especially when pressing out work.

To overcome this trouble he has extended the piston rod through the upper head and put on a cylinder of 6-inch bore and 20-inch stroke. This cylinder is filled with oil, and two small holes in the piston prevent the movement of the press piston in anything like a "sudden" way. This is a good improvement.

Another neat trick he uses is a light crosshead, or arms, on the piston rod, on which he hangs hooks. These hooks are placed under the flanges of a driving box, for instance, and when the piston rises, the box is lifted off the bed. This allows getting something under it, such as a light skid to slide it down to floor, or the end of a hand truck to carry it where wanted—saves lots of lifting.

Solid-Ended Main Rods.

On the D., G. H. & M. they are using a great many solid-ended main rods.

They use a pretty heavy end on the rod, especially the front end, and press in bronze bushes about ¼-inch thick.

Their eight-wheelers make from 50,000 to 60,000 miles without changing bushes, which would seem like a saving. The rods are lighter than strap rods, have no keys, keyways, straps or bolts, to say nothing of half brasses, all of which are expensive in first cost and maintenance.

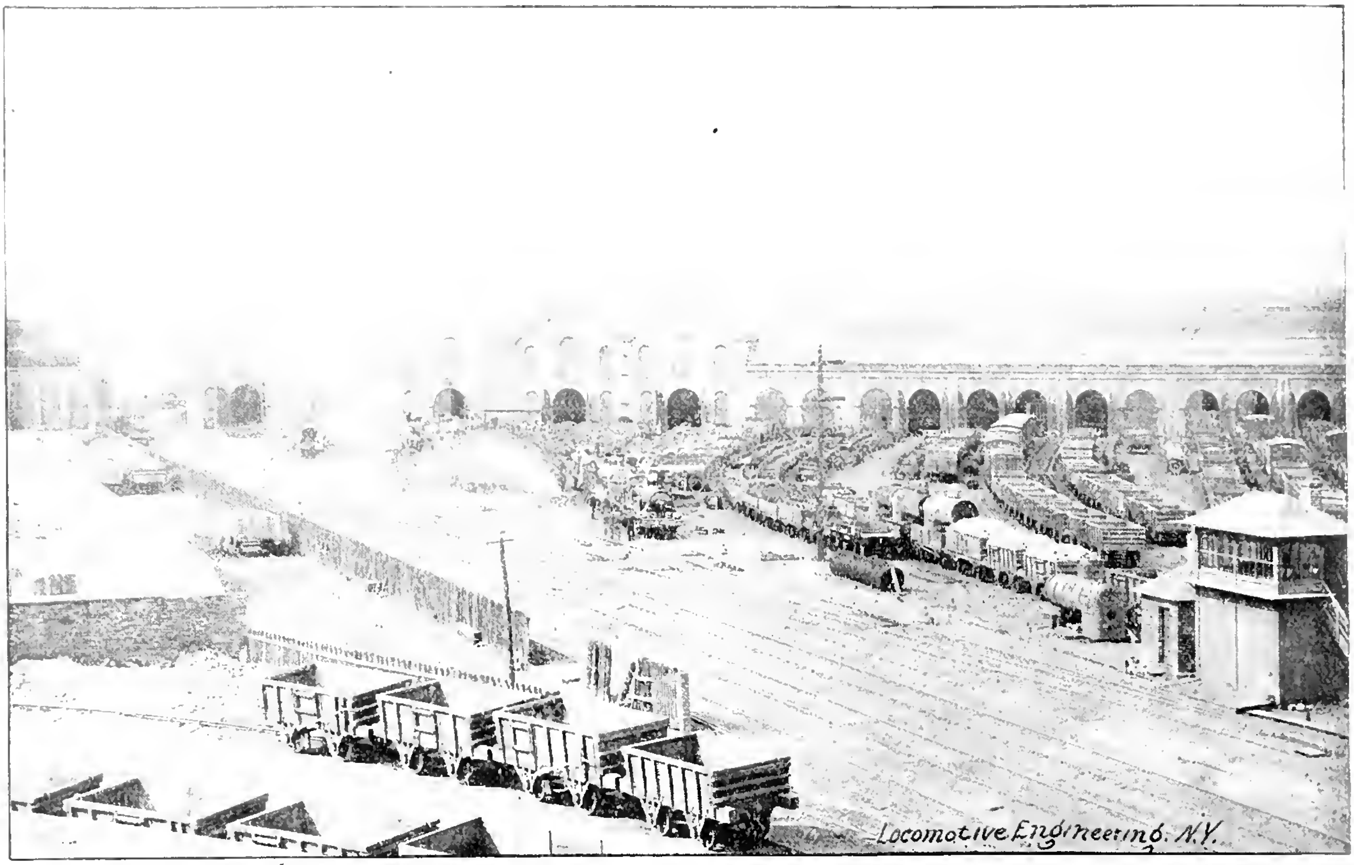
Where a solid front end is used on the main rod, it is necessary that the guide yoke be made so that the lower part of it can be taken down to get the rod out.

The Counterbalance Question.

During a recent long trip in the West the writer was impressed by the fact that at almost every shop visited they were weighing up and changing the counterbalance in their engines.

This is a live question just now, and more attention is being paid to it than there formerly was, but no new laws nor no new requirements have been discovered.

In all cases noted the weights were being increased; we did not find a case where counterweight was being taken out. This at first would seem to have been an error of the builders—a miscalculation. But when the wheels are weighed up and a difference in counterweight of *hundreds of pounds* in wheels on the same axle are discovered, it would seem to indicate that there was more guess work than measurement in the counterbalancing of the average locomotive. The epidemic of revising the counterbalance errors of the past will probably have the effect of making specifications of the roads more explicit and the builders more painstaking in this matter, the latter being highly preferable.



CALEDONIAN RAILWAY SHOPS. MAIN BUILDINGS AND YARDS.

Brakes on Engine Trucks.

A paper was read by Professor Lanza, of Boston, at the last meeting of the American Society of Mechanical Engineers, on the Application of Brakes to the Truck Wheels of a Locomotive, the facts given being based on experiments made with a locomotive on the Old Colony division of the N. Y., N. H. & H. R.R. A variety of very careful tests were made to demonstrate the effect of brakes on the engine

truck in helping to stop the engine or train. With the empty engine running at 60 miles an hour, stops were made in an average distance of 1,657 feet when the truck brake was employed. When it was cut out, the average distance needed to stop in was 2,149 feet, so there was a gain of 492 feet in distance from the use of this addition to the braking power.

When stops were made with a train of six cars, the truck brake did not prove of so much comparative advantage, but still it helped sufficiently to be of great importance in such cases as an open switch or a stalled way car being in front. At sixty miles an hour, with six cars and the truck brake in use, stops were made in 1,217 feet.

When the truck brake was cut out, it took 1,251 feet to make a stop. For lighter trains the truck brake was found more efficient. The tests appear to have proved that the truck brake is an important addition to the braking power of an engine.

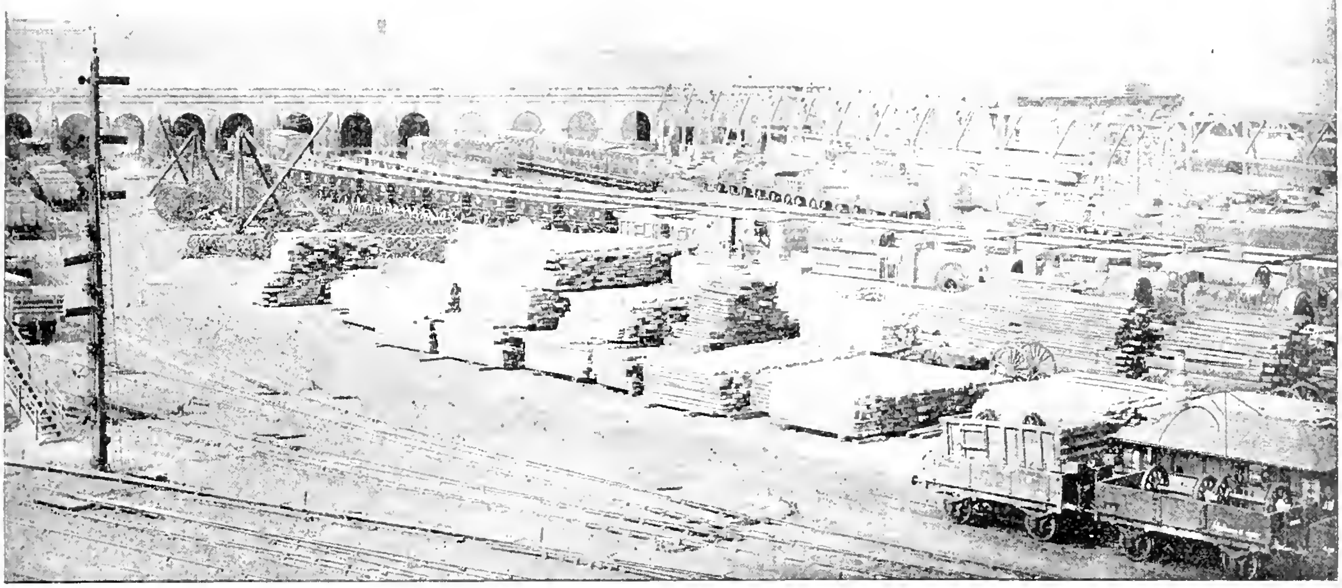
There appears to be some prejudice against this form of brake at present, just as there is still in many quarters against the driver brake. The sentiments that oppose the use of driving wheels and engine truck wheels as braking mediums are both based on misunderstandings. The increasing light on braking matters will gradually dispel the opposition to having brake shoes applied to those parts of the locomotive.

Cylinder Ratios of Compound Engines.

There are so many compound locomotives now in use in this country that nearly all intelligent engineers and mechanics are studying the designs of the engines and trying to find out the reasons why certain proportions are adopted. A thing which excites no little inquiry is the ratios of high to low pressure cylinders. A question frequently put to us is why is a ratio of 1 to 2 superior to a ratio of 1 to 4; and if greater expansion of the steam is the secret of saving, why not make a ratio of 1 to 5 or more?

There have been so many unexpected things found out with stationary compound engines, that we will not say that a greater ratio of low to high pressure cylinder would not be economical, but designers of compound locomotives are bound to permit the steam to exhaust at a pressure high enough to fan the fire. The accepted rules concerning the proportioning of compound engines say that the first consideration is to divide the power as equally as possible between the cylinders; next, to avoid an excessive rate of expansion in one cylinder, which would cause wide range of cylinder temperature; and thirdly, to avoid excessive drop in the receiver. These are reputed the three cardinal elements in a compound engine.

The power developed in the two cylinders can be equalized by adjustment of the cut-off in the large cylinder, no matter what the ratio may be between the two. The effect of increasing the ratio of expansion in the large cylinder is to increase the receiver pressure and, consequently, the initial pressure, at the same time increasing the back pressure in the small cylinder. If this is carried to excess, the small cylinder becomes merely a steam chest for the low-pressure cylinder. This has frequently happened in compound locomotives to those who were striving to prevent drop of pressure in the receiver. Recent tests with stationary compound engines indicate that permitting a drop of pressure in the receiver is not such a serious matter as has been supposed.



AS SEEN FROM ROOF OF THE PAINT SHOP.

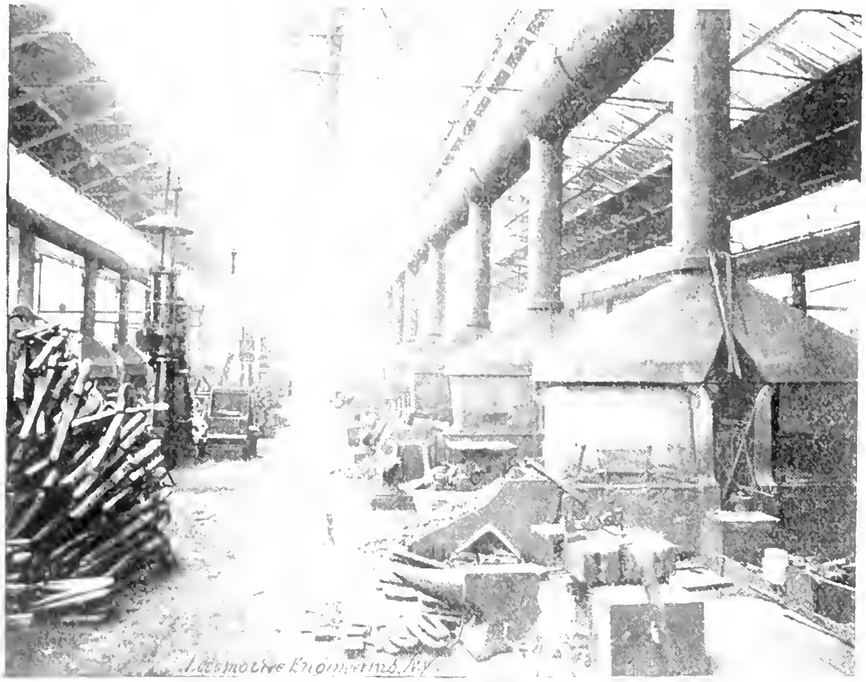
End Doors and Platforms Better Than Side Doors for Suburban Cars.

There is an erroneous belief that by the use of compartment cars with side doors, like those in use on many street cars in summer, suburban and urban passenger business could be carried on much more expeditiously than it is at present in the kind of car where all passengers have to enter and pass out by end doors. Last summer the writer rode considerably in the elevated railroad trains of New York and found that the stoppages at stations averaged about 9 seconds. This included the time of the heaviest traffic in the evenings.

Records of the same kind were made on trains of the Metropolitan Underground Railway, in London, and on the Western

Railway of France, running out of St. Lazare station. The stops on the Underground Railway averaged 41 seconds, and those on the French line were over 50 seconds. Both the European railways have compartment cars holding from 8 to 10 passengers. The cause of the delays appears principally to be that the passengers are permitted to get out very leisurely, and they frequently caused delays in getting on through searching for the class of car they intend to ride in. Then a great many doors have to be opened and closed, which wastes time.

With the kind of cars used on our elevated railways, there is a man on each platform ready to open the gate as soon as the train stops and to shout to the passengers to hurry up in getting off and on. Many people are inclined to resent the airy manner in which guards order passengers to step lively, but the practice is a decided stimulant to rapid transit.



CALEDONIAN RAILWAY SHOPS. THE SMITHY.

Wheels in the Wrong Place.

"When I was serving my apprenticeship," said the Traveling Engineer, as he put his feet on the seat opposite, "we had a crusty old M. M. who liked to appear the embodiment of all mechanical skill and knowledge to us youngsters. He never asked anybody's advice, always had an answer and a way to do things, and woe betide the mechanic who, by word or look, intimated that his way was not the best.

"We had several builds of old-fashioned engines, each a law unto itself in a great measure, yet there were two kinds of Rogers—a 15 x 22 with a 4½-foot wheel and a 16 x 24 with a 5-foot wheel.

"Well, in time one of the smaller ones hit a caboose and stove up her cylinders beyond patching, and she was laid aside.

"One day one of the larger ones broke a wheel center bad and there was much talk as to how it would be repaired; the engine was needed and our road did not boast of a pattern-maker, or a foundry, and the engine-builder was months away.

"When the foreman and the gang boss were figuring on it the 'old man' came home and the case was laid before him.

"'John Dolittle,' said he, severely, 'you are no manager, no thinker, no foreman; why in the name of James K. Polk are you standing around thinking how you can make a new wheel?—I'd like to see you general foreman of the Western Agricultural Works, where I was for eight years. Take the back pair of wheels out of the '18,' she's a Roger, and put them in the '12,' and don't stand there goppin' at me like you couldn't get an idea into your thick skull in a month o' Sundays!'

"'But, Mr. Seeder, I ——'

"'Don't Mister me! Get to work and get this engine jacked up and the '18's' wheels around here, and then call me—not a word, now—I'll teach you something if you stay with me long enough,' and he stamped away to his office.

"'Boys, you heard what he said, didn't you?' asked Dolittle.

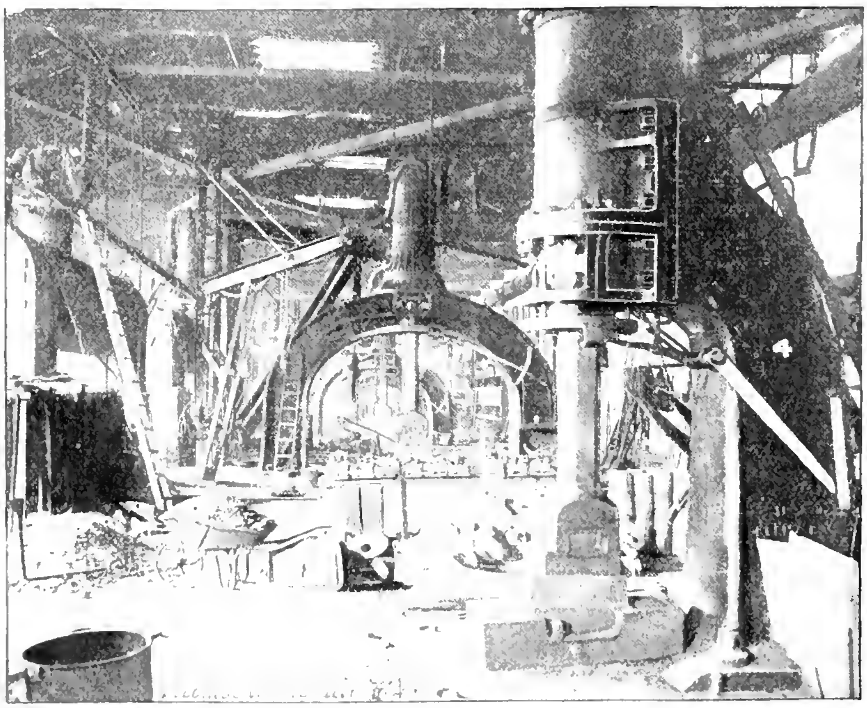
"'Yessir.'

"'Well, the main thing he said was 'Not a word,' and the first man that opens his yop I'll hit him with a crowbar. Git them wheels around here!'

"Towards night we got them around and the '12's' big broken pair away, then Dolittle rolled 'em under the jaws of the frame and sent for Seeder.

"He came in, all bustle.

"'Boys,' said he, 'git them boxes squared up and lower her down. She's agoin' out to-night. If I'd a' let John Dolittle have his way she'd a' been in the shop till spring.'



CALEDONIAN RAILWAY SHOPS. THE FORGE.

"Dolittle got off where he could get a nice side view and called Seeder over.

"'Mr. Seeder,' said he, 'ain't you got them wheels misplaced? My father was a wagon-maker, *but I allus noticed that he invariably put the smallest wheels in front!*'"

Railway Machinery in Great Britain.

[EDITORIAL CORRESPONDENCE.]

During a sojourn of about five weeks in the British Isles I enjoyed very good opportunities for seeing the various kinds of locomotives and cars in use, for I traveled a great deal and was given all necessary facilities for examining anything deemed worthy of special attention. Regarded from an American standpoint, the locomotives and cars are everywhere noteworthy for cleanliness and for being kept in first-class order. All the railways are by no means uniform in the outward care bestowed upon their rolling stock, but the worst that I saw would compare very favorably with the best practice on our side of the Atlantic. It was noticeable that the machinery of the lines south of London were inferior in general appearance to those north of the metropolis. How this should be I cannot say, but several well-traveled railway officers with whom I talked admitted that this was the case.

In their dealings with the public the railway managers in that part of the world are much more under control than their brethren are on this side. When an Englishman has any cause for complaint against a public corporation, he dearly loves to air his grievance by writing to the newspapers. When a railway company is the subject of an attack in the newspapers, it has a bad effect upon the earnings, for animosities are aroused which induce travelers to patronize rival roads. I have heard of a railway manager protesting that he cared nothing for the complaints of exacting travelers, who were always calling for new luxuries. His duty was to earn money for the shareholders. That, however, is an exceptional tone, and the managers do all in their power to avoid cause of offense, and when complaints are made a remedy is promptly applied, as a rule, if it does not cost much money.

I shall give a specimen of the complaints sent to the newspapers by English travelers. I traveled considerably on the Southeastern and thought that its rolling stock did not compare favorably with that of Northern lines, but the cars, although by no means clean, were models of tidiness compared with what can daily be seen on roads not a day's journey from New York. Yet the following is a letter that appeared in the *Pall Mall Gazette*. It is short but remarkably vigorous:

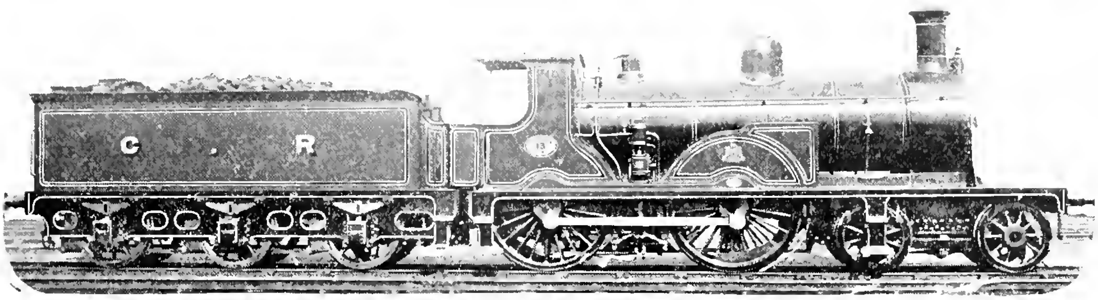


FIG. 1.

"SIR—The Southeastern Railway is the very worst railway in the world. Its engines are asthmatic, its lamps are trimmed by foolish virgins, its fares are excessive, its carriages let in the snow in winter and are furnaces in summer, its motto is unpunctuality, its principal station is approached through the neck of a bottle, it ruins the temper, destroys the digestion, and enables one to realize the horrors of Dante's Inferno—I am, Sir, yours obediently, The Worm who Turns."

A well-known English locomotive superintendent remarked to me, "What I admire about American railways is the uniformity of your rolling stock. The locomotives are confined to four or five classes, and the cars are all practically uniform. Now, look at our lines. There is not a single railway in the British Isles with locomotives or cars having parts that are interchangeable with those of another line."

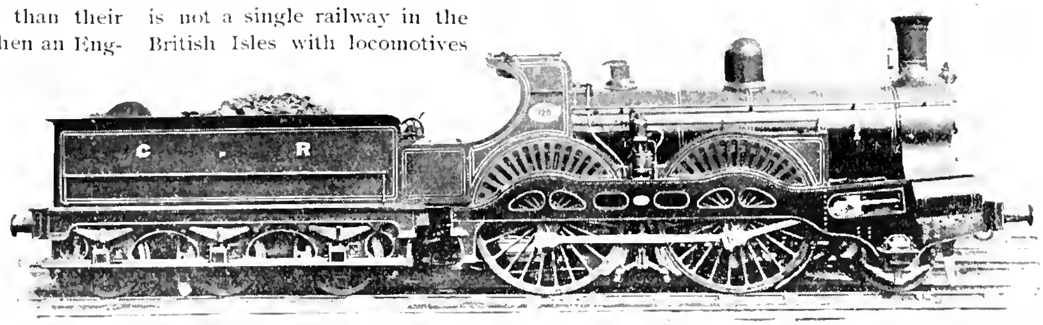


FIG. 2.

This man had visited America. He is a bright, intelligent engineer, and he went about making the best of his opportunities for observing what we have got. Yet the impression he received was a long way from being true. I did not attempt to disabuse his mind of the rosy impression he had received about our rolling stock. Before I crossed the English Channel again, I had, however, collected enough information about British rolling stock to convince me that their practice compare very favorably with ours, although they have no master mechanics or master car builders' associations to labor in the interests of uniform standard sizes.

When one stands at a busy junction point for an hour or two watching the numerous trains that pass, his first impression is that the types of locomotives are wonderfully numerous. But closer investigation reveals the fact that the diversity is due, in a great measure, to the persistent durability of certain old engines. The types are really not more numerous than those to be seen at Grand Crossing, near Chicago. For long years that extended up almost to the teens of the present generation, nearly all railways in Britain and elsewhere were experimenting to find what form of locomotive was best adapted to the particular requirements of the owners. Since they came to settle upon what we would call standards, they have adhered very closely to them, and there is every indication that when old engines wear out, the individual companies will have their machinery as nearly uniform as anything to be found in America.

The British locomotive has developed on lines slightly different from those followed by American improvers of motive power. The first few experimental locomotives, such as the "Rocket," were built with outside cylinders, but almost immediately the pioneer locomotive designers nearly all adopted the use of inside cylinders. The principal reason for this appears to have been that they could make a steadier running engine with inside cylinders. With the flimsy frames employed, and no wheel counterbalance, the outside cylinder locomotive of the early days was a tremendous wiggler.

When I was a boy working in the office of the locomotive superintendent of the Scottish Northeastern, at Arbroath, Scotland, there were two old engines that stood in the yard which were said to have been

built in the early 30's. They were very small affairs with outside cylinders, a single pair of drivers and hook motion, called in that country gab links. It happened that a great snowstorm blocked the line in the north, and one of these engines was steamed up to take a carriage of officials to the storm center. I was taken along to do the telegraph operating, and thought it would be fine to ride on the engine. I shall never forget the ride. The engine-driver was told to hurry, and he did. There is a certain kind of vicious pony to be seen in the West that appears to be moving in every direction at once when he is trying to buck off the rider. This engine appeared to be of that species. It plunged like a switching pony of short wheel base, it wiggled from side to side so that one could not stand on the foot plate without holding on, and it jerked the coupling as if it would break loose every moment. It was snowing hard, and there was no protection except the boiler, and the sparks fell over us in showers. It seemed to me that we were rushing to certain destruction, when about seven miles out we struck a snow drift two or three feet deep and stuck fast. The tubes were leaking, so the water soon got low, the fire was drawn, and we were drawn home ingloriously next day.

About 1840, outside locomotives came into favor with English designers, and the fashion kept up for about twenty years. Many of this kind of engine were built during that period, and not a few of them are still to be found in service on branches and small roads. About 1860, inside-connected engines came into fashion again, and this type is becoming general. There was for years a strong rivalry between the designers of inside and outside connected engines, but the former have come out ahead. The Caledonian Railway, in Scotland, and the Great Northern, in England, persistently held to outside cylinders, while nearly all other lines were adopting insides. Mr. Drummond brought the Caledonian into line with the majority, and now it looks as if all the other roads would follow suit.

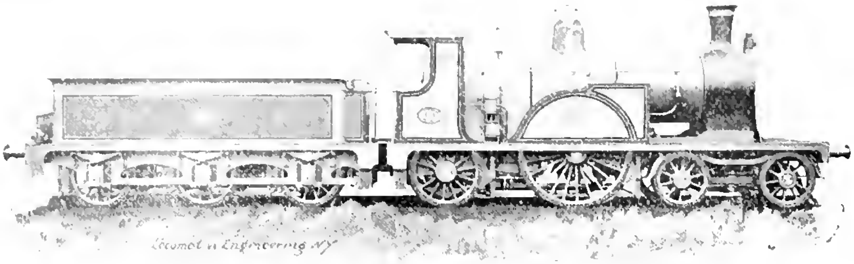


FIG. 3.

The principal reason for preference for inside cylinders, with all the disadvantages of a weak crank axle, appears to be that the flexible slab frame employed leaves the engine weak laterally and outside cylinders cause oscillation when the engine is working hard. As these people have never adopted cast-iron saddles, the girders used to brace outside cylinders together are too yielding, and the cylinders often get loose. As inside cylinders can be securely bolted together, a good, secure job is easily made. Then, of course, the power from inside cylinders is applied so near the center of motion that there is the minimum leverage exerted to cause oscillation. Another advantage claimed for the inside-connected locomotive is, that the cylinders being enclosed in the smokebox and warmed with the gases of combustion, there is less loss of heat from condensation.

Until quite recently, the most common form of passenger engine to be seen had one pair of large driving wheels, a single pair of leading wheels and a pair of carrying wheels under the foot plate. The heavy trains inaugurated by the introduction of the American cars upon the Midland, left the engines with single drivers too slippery for the work to be done, and now the engines for nearly all through passenger trains have two pairs of drivers coupled and a large four-wheel truck in front. A favorite type of this engine is shown in Fig. 1. The lines of this class of engine are said to have been worked out by Mr. S. W. Johnson, locomotive superintendent of the Midland Railway. The outside appearance is very pleasing, special care having been taken to make everything look smooth and simple. In this respect the simplicity is more apparent than real, for rather complex machinery and running gear are covered up by wheel covers and slab frames. When locomotive builders receive orders for locomotives with two pairs of driving wheels coupled behind, and a four-wheel truck in front, they nearly always follow the general design of the Johnson engine. It would be a good thing for American railroad interests if builders adopted a similar policy. It would militate greatly in the interests of uniformity if they would take such an engine as the New York Central's "999," and build locomotives after that model with the parts uniform.

A good specimen of the highest development of the British outside-connected locomotive is seen in Fig. 2, which at one time was the main-line engine of the Caledonian. Many engines that closely resemble this one are still to be seen on the Great Northern, the London & Southwestern, and a few other lines. The Great Northern still clings to outside-connected engines. The favorite for even heavy passenger trains has a single pair of drivers

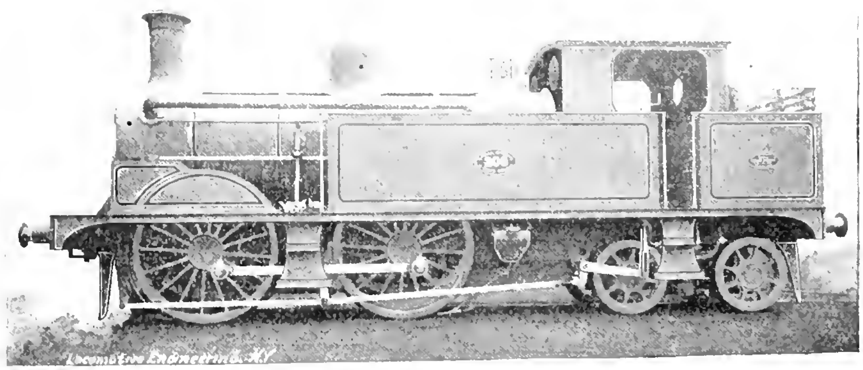


FIG. 4.

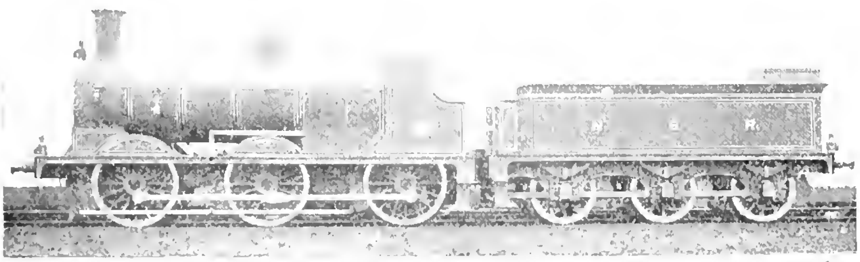


FIG. 5.

Most of the railway engineers with whom I have talked expressed the opinion that the day of single-driver locomotives had passed. When I was in Scotland, five years ago, Mr. Drummond, of the Caledonian, had just put in service the engine shown in Fig. 3, which was built by Neilson & Co., Glasgow, and had been exhibited at the Edinburgh Exhibition and attracted very favorable attention. The designer was very proud of the engine, and frankly asserted his belief that within ten years that style of engine would be working all fast main-line trains on every railway in Great Britain. The drivers are 84 inches diameter and the cylinders 18x26 inches. The steam pressure is 150 pounds and the weight on drivers 37,800 pounds.

The writer rode on this engine from Glasgow to Carlisle shortly after she was put in service. The train with the engine and tender weighed about 160 of our tons, and a long grade had to be ascended on the hilly borders of England, of about 70 feet to the mile. The engine dragged the train up this hill very slowly, and I concluded then that less wheel and more tractive power would have made an engine much better for the service.

No more of this class of engine has been built for the Caledonian.

An odd form of engine which is practically standard on the London, Chatham & Dover Railway is that shown in Fig. 4. This is a suburban engine, but the passenger engines for main-line service are of the same type, only that they have a tender.

The peculiarity of this engine is that the two pairs of coupled drivers are in front and a pair of small trailing wheels carry the weight behind. This form of engine was designed by Mr. William Stroudley, locomotive superintendent of the railway where they are used. It is a development of an early type of engine built by the Hawthorne Locomotive Works, Newcastle, which was a favorite in Scotland forty years ago. Mr. Stroudley was employed on a Scotch railway for many years. The leading advantage gained by this form is increased room for a long firebox. It could not be used safely on crooked lines. These engines are said to work heavy fast trains very economically.

Fig. 5 shows what may be considered the standard freight engine of the British Isles. Nearly all switching engines are of the same form. On different railways there are minor differences due to individual preferences, but the great majority of the engines are six-coupled with inside cylinders, straight boilers and a dome in the middle. The cylinders are generally about 18 x 26 inches and the drivers about 62 inches diameter. They are said to pull as heavy a train as it is safe to run. Nearly all British freight trains are what we would call light and run at a high speed. They have very few power brakes on freight cars, but the progressive railway officers are anxious to see brakes applied to all freight cars employed on fast trains.

Compound locomotives in England are confined almost exclusively to two railways, the London & Northwestern and the Northeastern. The former use Webb's design, which is too well known to call for description. On the latter road Worsdell two-cylinder compounds are used to some extent. It is stating the case mildly to say that I found no enthusiasm in England about compounds and less in Scotland. Train loads in the British Isles are so light, as a rule, that the locomotives can do their work while cutting off at quarter stroke. This leaves little margin on which to work up economical performance for a compound.

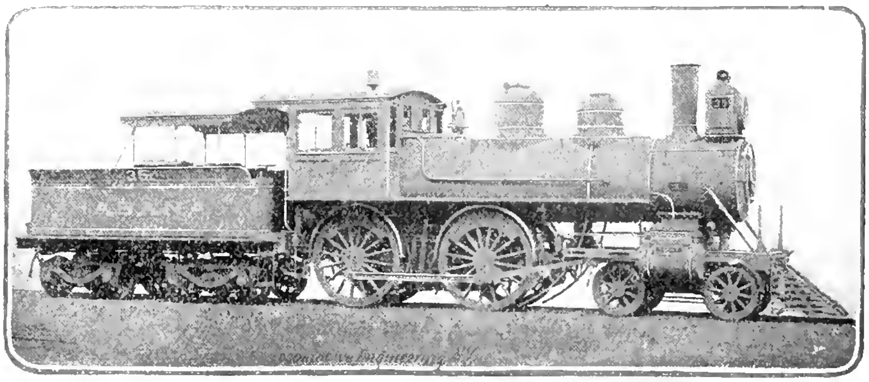
A. S.

Some Modern Power for the Cuban Railways.

There has been some consolidating of Cuban railroads recently, and modern power has been purchased to handle their traffic.

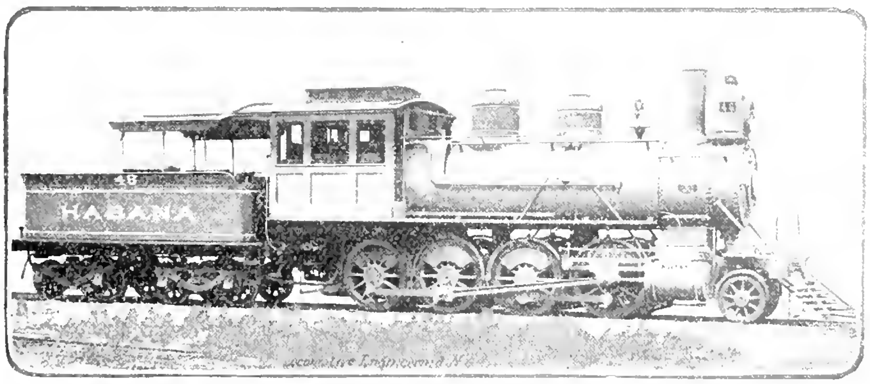
The Rogers Locomotive Co., of Paterson, N. J., have recently furnished a number of locomotives of the latest design, pictures of which are shown herewith.

The passenger locomotive is the regulation American eight-wheeler, having 17x24-inch cylinders, 72-inch drivers, with a rigid wheel base of 8 feet 6 inches and a total wheel base of 22 feet 11 inches; the gauge is 4 feet $8\frac{1}{2}$ inches. This engine weighs 96,000 pounds, 60,000 of which is on the drivers.



Standard Passenger Locomotive for Cuban Railways.

The freight engine is of the consolidation class, has cylinders 20 x 24 inches, drivers 54 inches in diameter, a rigid wheel base of 15 feet 2 inches and a total wheel base of 22 feet 10 inches, weighing 132,600 pounds, 116,000 of which is on the drivers.



Standard Freight Locomotive for Cuban Railways.

The day of the little, old coffee roasters that passed for locomotives in Cuba, a few years ago, has evidently gone by.

M. C. B. Standard Sizes of Publications.

We have received numerous inquiries lately as to what are the standard sizes of pamphlets and catalogues adopted by the M. C. B. Association. For the information of our readers, we give the sizes, and advise those who wish to adopt the sizes to make a note of them now.

Annual reports, 6 x 9 inches.

Postal card circulars, $3\frac{3}{4}$ x $6\frac{1}{4}$ inches.

Pamphlets and trade catalogues, $3\frac{1}{2}$ x 6 inches; 6 x 9 inches; 9 x 12 inches.

Specifications and letter paper, $8\frac{1}{4}$ x $10\frac{3}{4}$ inches.

It will be seen that the new form of Locomotive Engineering conforms to the largest pamphlet standard size.

A correspondent attributes the flattening of tire which follows the use of full throttle with locomotives as being due to the engine's having too much valve lead.

LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Steam Throttling Sometimes Beneficial.

A principle of engineering which has long been urged upon locomotive engineers by scientific theorists is that running an engine with the throttle valve partly closed is certain to result in waste of steam. The principle was given as grimly inflexible, one of the rules to which there is no exception. The mathematics of steam engineering seemed to demonstrate that as truth. The engineering world took the word of the mathematicians who had figured out the problem, and of the physicists who had made careful experiments and found that throttling led to waste of fuel, and railroad motive power officers encouraged the engineers to keep the throttle wide open. Many engineers of keenly observing habits, men who were willing to obey the recommendations of those above them, found that under certain circumstances less fuel would be used when running with the throttle partly closed than when the speed was regulated by the reverse lever alone.

The writer, who was for years a firm believer in the open throttle, received a lesson about three years ago which caused him to modify his views, and since then he has been very tender about accusing men of bad practice who ran with the throttle partly closed. The lesson came in this way. We were riding with an exceptionally intelligent engineer on a fast passenger train on one of our trunk lines, and we noticed that he was running with the steam partly throttled. This was a surprise, because the traveling engineer of the road is a decided believer in giving the steam full opportunity to work expansively. On talking to the engineer about his method of working the engine, the information was brought out that he ran with a full throttle the most of the time in one direction and in the other with the steam throttled. His reason for doing this was that he liked to avoid a certain water tank, and he had more water in the tender when he ran in that direction with the steam throttled. If that was the case, why did he run in the other direction with the throttle full open? The reply to this question was that, although it seemed unreasonable to say so, he used less water on the other run by running with a full throttle.

It has been our intention, ever since the facts mentioned were learned, to take indicator diagrams of the engine on the two trips, with the idea that it might be possible to demonstrate why throttling might be an advantage; but various difficulties came up that were not overcome, and so this test is yet among the good intentions. We found, however, that the division rises considerably, and that it was while running towards the lower level that throttling was done. When on the ascending run, the engine could be worked at 9 inches cut with a full throttle, and sometimes another notch ahead was required. In the other direction a great part of the work could be done cutting off at 6 inches with a full throttle, but that the engine rode easier and used less water when cutting off at 7½ inches with the steam throttled.

These facts have received new significance for us from a paper read by Mr. Charles T. Porter at the last meeting of the American Society of Mechanical Engineers, on "Comparison of the Action of a Fixed Cut-off and Throttling Regulation with that of the Automatic Variable Cut-off, on Compound and Triple Expansion Engines." This paper does not deal with locomotive engine problems, but the principles that affect one form of engine have more or less bearing upon all others. Mr. Porter is one of the most eminent steam engineers in the world, and therefore his views carry great influence. He is author of the well-known book on the Richards Indicator, and is inventor of a high-speed automatic cut-off engine that has been largely used on this continent. In the paper, he holds that the subject uppermost in engineering thought is, cylinder condensation and how to prevent it. The losses from cylinder condensation are known to be so serious that, in the judgment of prominent builders of variable expansion engines, at an early cut-off the steam losses are in excess of that employed doing useful work.

The most simple remedy for this, he asserts, is the expanding of the steam through two cylinders or, in other words, compounding, which prevents excessive range of cylinder temperature. The statement is made that the high pressures coming into use cannot be worked successfully in a single cylinder, owing to the enormous losses due to cylinder condensation when an early cut-off is necessary. When the variable cut-off is employed on engines, whether simple or compound, working under large changes of resistance, the cut-off is continually running to wasteful points of the stroke, some of them exceedingly wasteful. Although the theoretical gain by early cut-off is considerable, it is outweighed many times over by the increase in the losses from condensation. The author insists that engines worked under the foregoing conditions will be improved by having a fixed cut-off established with a throttling governor, which will lead to the superheating of the steam before it reaches the cylinder.

Applying the theories advanced by Mr. Porter to the locomotive, we can easily perceive how loss of steam may result from a very early cut-off. The cylinder, steam chest and steam passages of a locomotive are peculiarly exposed to loss of heat from atmospheric influences. For this reason a ratio of steam expansion that may be economical with a well-protected stationary or marine engine cylinder may be wasteful with a locomotive. The high boiler pressure becoming general induces a great range of cylinder temperature. Thus, at 180 pounds gauge pressure the steam has a temperature of about 379 degrees Fahr. When this steam falls down to a pressure of, say, 30 pounds absolute, or 15 pounds by the gauge during the period of exhaust, its temperature descends to 250 degrees, and this acts to reduce the metal of the cylinder and exhaust passages to its own temperature.

It has no sooner performed this chilling business than the steam from the boiler, of 180 pounds gauge pressure and 379 degrees temperature, is entering the cylinder to perform the work of next stroke. Steam will not remain gaseous when exposed to a temperature lower than its own, and the first act done by the hot admission steam is to warm up the metal of the cylinder. In this way the cool cylinder acts as a veritable condenser on the hot incoming steam. We use the expression cool in a comparative sense. The "cool" cylinder is hotter than boiling water, but the difference between it and the incoming steam is about the same as stepping from the heat of a scorching summer day into a refrigerator 30 degrees below zero. This will give an idea of what "the range of cylinder temperature" means.

Another fact to be considered in connection with the argument that under certain circumstances delaying the point of cut-off may save steam is, that when steam is expanded from a high to a lower temperature without abstraction of heat, or without doing work, a superheating of the gas results. Thus, if the steam is reduced from a pressure of 180 pounds to 120 pounds, say by throttling, the temperature, instead of falling to 350 degrees, is likely to be about 370 degrees or more. This 20 degrees of superheat is a margin which must be used up before condensation of the steam takes place. If there is sufficient extra heat in the steam to raise the

cylinder metal without causing condensation of steam, it is likely to save more heat than that brought in by superheating, for it is well known that moist vapor has a great capacity for carrying away heat.

In the case mentioned where a locomotive saved steam while throttling instead of using a short cut-off, it may have been that the range of cylinder temperature was too great when the short cut-off was employed. When cutting off at $7\frac{1}{2}$ inches there was less expansion, and the steam escaped from the cylinder at a temperature sufficiently high, so that the admission steam did not have much metal heating to do. When cutting off at 6 inches the loss from steam condensation was greater than the loss due to the greater volume admitted for the longer cut-off. There may have been other causes for heat loss at work with the shorter cut-off, which could only be identified by careful tests; but there is no doubt that the cylinder condensation is sufficient to account for the waste of steam.

While taking the stand that circumstances sometimes exist to support D. K. Clark's saying that expansive working is expensive working, this is not, we believe, the rule on American railroads. Locomotive operating expenses have been habitually kept up by the practice of throttling steam under all conditions of cut-off. As a rule, an open throttle will produce the best results, but recent experiments with steam engines show that the rule has exceptions.

Engine Proportions That Do Not Agree with Text-Book Proportions.

We frequently hear engineers talking about the possibilities of compounding for locomotives, as if it were a settled fact that what can be done successfully with a stationary or marine engine may be done successfully with a locomotive. A paper read by Mr. F. W. Dean, at the meeting of the Society of Mechanical Engineers, gives some facts which are really striking illustrations of the great difference between stationary engines and locomotives in their capacity for being improved by compounding. The designers of compound locomotives are getting beyond their depth when they exceed a ratio of 1 to 3 in the cylinders of compound locomotives. Mr. Dean gave particulars of tests of a compound Wheelock engine of the Rockwood compound type, which had a ratio of 1 to 7, and did the work on a water consumption of 12.84 pounds per horse-power per hour. This is about as good as any performance recorded of triple expansion engines. Another thing illustrated by the tests described by Mr. Dean is the vast amount of information about compound engines that has yet to be found out.

One of the many theories held about compound engines is that every effort should be made to limit the drop of steam pressure in the receiver as closely as possible. When the ratio of cylinder proportions is great the drop in the receiver pressure is certain to be excessive. This is supposed to reduce the economy in the use of steam. The Rockwood design of engine provides for a drop in receiver pressure that theory would decide to be ruinous on the coal pile; yet this highly defective engine does its work with as small steam consumption as any of the elaborate engines that are supposed to be masterpieces of scientific designing. It looks as if the text-books on steam engine designing are as much in need of readjustment as the text-books on the melting-point of metals.

Stealing Inventions.

To follow up from their beginnings, the evolution and development of many kinks in applied mechanics, would be highly interesting if all the facts were obtainable; but, unfortunately, the finished product is so often the result of different minds that its paternity is questionable, if not entirely lost in a horde of daddies.

The party in whose brain the germ originates is too often the one who has the least credit in the final verdict. It is the improver on the idea who generally gets away with the fame and emoluments. The would-be improver—the fellow who never had an original idea in his life—is the terror to inventors, for he does not scruple to steal the child of any man's intellect; he will copy all essential details of a device as faithfully as the storied Mongolian, not always being sure that he does not approach the danger line near enough to be liable to a well-merited prosecution for infringement. We all know him; he lies in wait for some one to spring a new thing on us, when our friend straightway begins to lose sleep in his masterly effort to *get around it*, as he is pleased to call his ghoulish act.

There are lots of these rascals unpunished to-day, who are wallowing in "purple and fine linen," by reason of their talent in appropriating to their own use the mental offspring of the man who thinks. Verily! the thug who invites you to hold up your hands is covered with saintly halos when compared with this buccaneer.

Holding Owners Responsible for Their Cars.

The appearances are, that the railroads of this country are about to inaugurate changes in the regulations of car interchange, which amount practically to a revolution on existing practice. The rules that govern railroad companies in their handling and care of foreign cars have grown up slowly for thirty years. They have been the object of fierce controversy and of numerous changes, but with all the objections and all the changes, one principle has been adhered to till within a few years, viz.: that the railroad company having a car on their road should be responsible for any failure to the car or its parts, and deliver it in as good a condition as it was in when received. A modification of this principle was introduced three years ago, when a rule was established holding the owners of cars responsible for defects of car roofs, for brake shoes worn out, for journal bearings needing renewal and for a few other defects. This change excited fierce opposition at first, and persistent attempts were made to have it repealed, but the opposition was never powerful enough to force a return to the old practice.

What really brought about the change was, that those in charge of rolling stock came to realize that certain owners of private cars were in the habit of working so, that the railroad companies were compelled to do the greater part of the repairs to private cars without receiving compensation. The working of the rule holding owners responsible for bearings and brake shoes put the expense of these renewals where they belonged, and it began to dawn upon those who had got the rule established that it might be extended with advantage to many other parts of a car. Accordingly, a number of the members of the Master Car Builders' Association combined in a movement at last convention, to have the rule amended to include all the parts of a car that are most liable to need repairs through the stresses of regular service. They were not sufficiently numerous to get the additions incorporated in the Interchange Rules, but they went away determined to agitate for the change and to educate other railroad men to their way of thinking. This has now brought forth practical fruit, by nearly all the principal railroad companies entering Chicago forming an agreement to accept cars from each other without cards for twelve defects that require carding under existing rules. If repairs must be made before the car returns to the owner, the latter agrees to pay the expense of the same. The plan is reported to be working satisfactorily, and is said to facilitate decidedly the movement of cars. Under its working sufficient experience will be obtained before next convention to demonstrate whether or not it is a change that will benefit the roads by general adoption.

It appears to us that more people than the owners of private cars will be brought to justice by this new rule. Railroad companies, which put first-class material into their cars and build them to wear well, have been at a disadvantage with those who bowed the knee at all times to cheapness, and habitually put cars upon the road which were fragile in every part. When the weak cars were subjected to the severe shocks of heavy service they were always failing, and the company on whose lines they were running had to do the repairs. We have all heard about the practice, some roads have followed, of making bearings with cast-iron shells to be used in foreign cars, and of cast-iron M. C. B. couplers made to be used in a similar way. An im-

portant change like that of holding owners responsible for the repairs of their own cars when they are away from home, cannot be carried out without inflicting hardships in some quarters; but we believe that the general effect will be beneficial to those who have first-class cars and embarrassing to those who have poor cars or who are given to sharp practices that are not fair between man and man. If its effect will be as indicated, to facilitate the movement of cars, railroad companies can afford some annoyance in other directions.

One of the most interesting annual railroad reports which comes to this office is that of the Maine Central, that for 1894 being now before us. That road, like all others, has suffered from the business depression, but the policy of the management has been to maintain the property in first-class condition, although the policy of retrenchment and reduction of expenses has been carried out, where possible, without injury to the property. The gross earnings, as compared with the previous year, are reduced almost $400,000, but the net earnings are less than $40,000. Many contemplated improvements have been postponed, but no essential work for maintaining the safe physical condition of the system has been put off. Two expensive bridges have been built, several new stations have been erected, 41 miles of new steel rails have been laid, twenty old locomotives have been replaced by new ones, and 100 new freight cars have been added to the equipment. The way the property has been managed reflects credit on the able vice-president, Mr. Payson Tucker. The locomotive department has been run for 17.72 cents per mile, the repairs only figuring 2.56 cents per mile, which is exceptionally low. This is creditable to Superintendent of Motive Power Pilsbury.

BOOK REVIEWS.

POOR'S DIRECTORY OF RAILWAY OFFICIALS AND MANUAL OF STREET RAILWAYS.

This book has recently reached this office. It contains the names and addresses of all railroad officials on this continent who are in any way influential in the purchase of supplies, and of many who have no such influence. The roads are arranged alphabetically in the usual way, and the names of the leading officers given. Then there are separate divisions for master mechanics, master car builders, purchasing agents, chief engineers, master car painters, general managers and general superintendents. To this is added an official list of street railways which seems to be quite complete. We have examined the list very carefully, and think it is free from the blemishes which it contained last year. It is sold by the publishers, H. V. & H. W. Poor, New York, for $2.

THE CONSTRUCTION OF THE MODERN LOCOMOTIVE. By George Hughes. Spon & Chamberlain, 12 Cortlandt street, New York. Price, $3.50.

This book has been written by the assistant chief mechanical engineer of the Lancashire & Yorkshire Railway, at Horwich, England, and gives an excellent description of how an English locomotive is constructed. The work is done with extreme care, and is well illustrated with engravings made from detail working and finished drawings. The only fault we have to find with the book is that the engravings are not worthy of the masterly way the book is written.

The book begins with a description of how a boiler is made, with incidentally a good many facts about the quality of boiler plate, specifications of and method of working the same, and the tests it is subjected to. Here and all through the book we find many things mentioned as being done as a matter of course which are very seldom done in this country. All the manipulations that the plates go through from the time they reach the boiler shop until they form a boiler ready for steam, are described with careful minuteness, and nearly every operation is made clear by cuts. The various tools which are used in doing the work are also illustrated and described.

Next section deals with the foundry, which leads to a treatise on iron and castings. Here the author takes occasion to tell his readers that it is a mistake to suppose that American castings are better than those made in English foundries, in which we are inclined to think that he is going beyond the region of fact. The description of how the various castings are used in a locomotive is, however, very good, and we readily forgive any prejudices in favor of the writer's own country. A second section of this article treats of steel castings, in which we are informed that these castings have now been substituted for forgings to a remarkable extent, about forty articles on a locomotive that formerly were forged being now made of cast mild steel. The case is mentioned of a cranked axle made in this manner which had run over three hundred thousand miles. Numerous details are given of how they make steel forgings in the Horwich shops.

Forging and The Smithy cover the operations performed by the blacksmith, and do it very well. In these sections a great deal of attention is bestowed upon formers and labor-saving methods employed by the workers in wrought iron. We regret that want of space prevents us from giving more particulars of this interesting part of the book.

The other subjects treated are Coppersmithing, The Machine Shop and Erecting. The section on the machine shop begins: "Machine shop economy is summed up by developing every machine to its utmost efficiency and obtaining the maximum output from each, consistent with the requirements and nature of the work." This is the text that is rigorously preached throughout all the parts relating to production of finished parts. Machine tools, *per se*, do not receive much direct attention, but the work turned out is treated as of paramount importance. The author appears to appreciate the value of the milling machine, and thereby shows that he is away ahead of prevalent shop ideas in England. Numerous details are given of the methods employed in finishing and fitting work, and a great many templates, jigs and holders are illustrated. Mr. Hughes is fortunate in the fact that he has the best-equipped and best-managed railway shop in Europe to describe the operations of, and he has proved himself a worthy delineator.

SIXTH ANNUAL REPORT OF THE INTERSTATE COMMERCE COMMISSION ON THE STATISTICS OF RAILWAYS IN THE UNITED STATES.

We are indebted to Mr. Edward A. Moseley, Secretary of the Interstate Commerce Commission, for this valuable book, which gives so many interesting facts about the railways in the United States. The report contains so many facts, is brimful of so much important information, that we have not yet been able to give it more than a superficial examination. It gives the mileage, earnings, operating expenses and indebtedness of all our railways with elaborate minuteness, and in every particular may be accepted as correct. Besides these facts there are particulars concerning the classification of railways, the equipment, men employed, railway accidents, and a great variety of other things of interest to men in any way connected with railway matters.

A fact which becomes impressed upon the reader of this report is that the Interstate Commerce Commission is doing a valuable work in making the public understand how efficiently and cheaply railway companies render their services to the country. Those who consider that the country is suffering from the exactions of fat railroad corporations, will have their views changed if they will only study this impartial report sufficiently to understand what the owners of railroad property receive on their investments. But the influence of the Commission is not by any means devoted to the defence of railroad companies. That merely comes out incidentally. The tendency of the Commission, in fact, is to hold the railroads to closer responsibility in their dealings with the community. Their influence is exerted in favor of the general introduction of safety appliances and in preventing discrimination in favor of large interests as against small ones. As far as we can see, the entire influence of the Commission has been exerted in the interests of justice.

The report may be obtained from Mr. E. A. Moseley, Secretary Interstate Commerce Commission, Washington, D. C. No price has been given.

PRACTICE AND THEORY OF THE INJECTOR. By Strickland L. Kneass, C. E. John Wiley & Sons, New York. Price, $1.50.

This is a book of 150 pages 7 x 9 inches, and contains more injector literature than has ever before been put in one book. It gives a highly interesting account of the early history and development of the principle on which the injector acts, then it proceeds to give details respecting the designs and operation of injectors. All the principal injectors in use in this country and in Europe are described and many of them illustrated. Particulars are given which show that the author is an expert on the subject he writes upon. The book bears every evidence of careful, reliable work and deserves to be accepted as a hand-book on the injector.

EQUIPMENT NOTES.

The Washington Coal Co. are asking bids on 300 coal cars.

The Oliver Coke & Furnace Co. are in the market for 100 cars.

The Wheeling & Lake Erie are asking bids on twelve passenger cars.

The Pennsylvania Railroad Company are said to have ordered 1,000 cars for the lines west of Pittsburgh.

The Missouri, Kansas & Texas are said to be about to contract for 700 furniture, 800 box and 500 coal cars.

The Buffalo, Rochester & Pittsburgh are said to have contracted with the Union Car Co. of Buffalo for 200 cars.

The Michigan-Peninsular Car Co. have received an order from the Columbus, Hocking Valley & Toledo for 1,000 cars.

Flint & Co., of New York, are reported to be asking for bids for 250 iron freight cars and 200 passenger cars for railways in Brazil.

The St. Paul & Duluth are asking bids on about five passenger cars, to replace those which were burned in the forest fires last September.

Mr. Marden, superintendent of the car department of the Fitchburg, has received orders to build twenty-four new passenger cars in the shops at Fitchburg.

The Southern Railway have placed an order with the Lenoir Car Works, Lenoir, N. C., for 400 hopper-bottom coal cars. This car company have also an order from the Knoxville & Ohio for 100 cars.

The Baldwin Locomotive Works are building four consolidations for the Toledo, Peoria & Western, some engines for the State Transcaucasian Railway of Russia, some for the Leo Poldina of Brazil, one for the National Tube Works, and one for an iron company.

The Texas Midland have received six passenger cars from the St. Charles Works, which are equipped with all latest improvements in car building, including electric lights and steam heating apparatus. The same company have received from the Schenectady Locomotive Works two locomotives that have electric headlights. They are said to be the first engines in Texas with this improvement.

PERSONAL.

Mr. John Horrigan has been appointed master mechanic of the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill.

Mr. E. T. Carlton has been appointed master car builder of the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill.

Mr. F. H. Clark has been appointed chief draughtsman of the Chicago, Burlington & Quincy at Aurora, Ill.

Mr. George W. Cushing has resigned the position of master mechanic of the Cincinnati, New Orleans & Texas Pacific.

Mr. L. E. Johnson has been appointed superintendent of the Michigan division of the Lake Shore & Michigan Southern, with headquarters at Toledo, O.

Mr. S. K. Dickerson, of the Roanoke Machine Works, has been appointed master mechanic of the Norfolk & Western, with headquarters at East Radford, Va.

Mr. R. H. Nicholas has been appointed superintendent of the New York, Philadelphia & Norfolk, with headquarters at Norfolk, Va., to succeed H. W. Dunne, deceased.

Mr. R. E. Eavenson, heretofore assistant general manager of the Williamsport & North Branch, has been appointed general manager of that road, with headquarters at Hughesville, Pa.

Mr. A. R. Woods, formerly connected with the Mexican Central, has been appointed general superintendent of the Interoceanic Railway of Mexico, with headquarters at the City of Mexico.

Mr. M. F. Bonzano, general superintendent of the Philadelphia & Reading, has been promoted to be assistant superintendent of the South Jersey Railroad, with headquarters at Cape May, N. J.

Mr. E. V. Sedgwick, formerly master mechanic of the Mexican Central, has been appointed superintendent of motive power of the Interoceanic Railway, with headquarters at the City of Mexico.

Mr. A. B. Johnson, of the Baldwin Locomotive Works, Philadelphia, Pa., who has been in Brazil since last spring, has returned. He looks as if living at the other side of the equator agreed with him.

Mr. F. E. Smith has been appointed roundhouse foreman of the St. Louis Southwestern at Pine Bluff, Ark. Before coming to this road, Mr. Smith was on the Rio Grande Western at Salt Lake City.

Mr. B. F. Kelsey has been appointed Western representative of the Columbian Metallic Packing Co., of Philadelphia, with headquarters in the Manhattan Building, Chicago. He was formerly with the Midvale Steel Co.

Mr. C. H. Quereau, engineer of tests of the Chicago, Burlington & Quincy, at Aurora, Ill., has been appointed assistant to the superintendent of motive power of the Burlington & Missouri River, with headquarters at Platsmouth, Neb.

Mr. Arthur G. Wells, who recently resigned as assistant to First Vice-President Robinson of the Atchison, Topeka & Santa Fé, has been appointed general superintendent of the Atlantic & Pacific, with headquarters at Albuquerque, N. Mex.

Mr. J. L. Frazier, formerly superintendent of the San Joaquin division of the Southern Pacific, is now superintendent of the coast division and the San Francisco terminals of all the overland lines of the Southern Pacific Company, with office at Third and Townsend streets, San Francisco.

Mr. C. C. Leech has been appointed to the position of general foreman of the Western New York & Pennsylvania shops at Buffalo, N. Y. Mr. Leech learned the machinist trade in the shops of this road at Oil City. For several years he has been foreman of the Pittsburgh & Western shops at Foxburg, Pa.

Mr. John D. Campbell has been appointed superintendent of motive power of the Buffalo & Susquehanna, with headquarters at Austin, Pa. Mr. Campbell was for several years assistant superintendent of motive power of the New York Central, and superintended the equipping of the fine shops at Depew, near Buffalo.

Mr. M. I. Spaulding has been appointed acting assistant mechanical superintendent of the Canadian Pacific Railway, with headquarters at McAdam Junction, N. B., in place of Mr. G. A. Haggerty, resigned. Mr. Spaulding was formerly an engineer on the Canadian Pacific, and was promoted about two years ago to be foreman at a division point.

Mr. W. F. Bradley, master mechanic of the Toledo, Ann Arbor & North Michigan, has been appointed general superintendent of the road. He will continue in direct charge of the mechanical department. Mr. Bradley is a member of the Master Mechanics' Association, and took an active part in the discussions at the last two conventions.

Mr. F. H. Soule has been appointed general inspector of the New York, New Haven & Hartford car department. He has been for several years on the Lake Shore & Michigan Southern in a similar capacity, and is spoken of by his superior officers as a most efficient inspector. He learned his business on the Fitchburg Railroad, under Mr. Marden.

Mr. J. J. Thornton, late foreman at Ellensburg, on the Northern Pacific, has been appointed foreman of roundhouse at Albina, on Oregon Railway & Navigation Line. This is a well-deserved advance for a man who knows his business. He will be remembered as one of the organizers of the Railway Master Blacksmiths' Association, and its first president.

Mr. Edward W. Jackson has been appointed general manager of the Interoceanic Railway of Mexico. Mr. Jackson is an Englishman by birth. He was trained

as a civil engineer, and spent some time in railway service in Turkey. For nearly thirty years he has been connected with railways in Mexico. For the last ten years he has been general manager of the Mexican Central.

Mr. W. H. Fenner, Jr., well known to railroad and supply men from his former connection with the Rhode Island Locomotive Works and the Allen Paper Car Wheel Co., has been elected president of the National Car Wheel Co., at Buffalo, and W. W. Turlay, of the same city, who has acted as manager of the company since its organization, two years ago, has been elected vice-president and treasurer.

Mr. John N. Reynolds, 140 Nassau street, New York, has issued his annual handbook, forming a directory of the street railway companies in the United States and Canada. It is very conveniently arranged, and gives a great deal of useful information concerning street railways; among this the names and addresses of officials. It is very handsomely bound in morocco, in a size convenient for the pocket.

At the December meeting of the American Society of Mechanical Engineers, Mr. E. F. C. Davis, general manager of the Richmond Locomotive Works, Richmond, Va., was elected president. This is the first time that a member connected with railroad machinery interests has been so honored. Mr. Davis is one of the most respected members of the society, and he is certain to make a successful presiding officer.

Mr. W. H. Selby, who was elected an honorary member of the Railway Master Mechanics' Association at last convention, died at his home at Moberly, Mo., last month, aged 62 years. Mr. Selby was an Englishman by birth, and began work in this country as a machinist on the Ohio & Mississippi. There he rose to be shop foreman, and then went to be general foreman of the Wabash, where he afterwards rose to be master mechanic.

Mr. Henry Bartlett has been appointed superintendent of motive power and machinery of the Boston & Maine, with headquarters at Boston. Mr. Bartlett has been an assistant mechanical engineer of the Pennsylvania Railroad at Altoona, Pa. He began railroad work in the machine shops of the Boston & Lowell, but finished his apprenticeship at Altoona. His father is treasurer of the Boston & Lowell Railroad, now absorbed by the Boston & Maine.

We have received from Roberts, Thorp & Co., Three Rivers, Mich., a finely illustrated catalogue of Cyrus Roberts' patented hand cars. The special claims made for this hand car are lightness, strength, durability and convenience. Years of experience in the making of this class of car, intelligent study and careful engineering tests have been brought into service in making the car as nearly perfect as possible. Those interested in hand cars should send for the catalogue.

Mr. E. B. Thomas, who has been first vice-president of the Erie system for the last four years, has been elected president. Mr. Thomas has managed the entire operating of the system, and it has been better managed than this property ever was before. If he cannot put the property upon a sound financial basis, no other need attempt it. He organized the operating departments on the Pennsylvania Railroad plan and it works very successfully. Mr. Thomas is president of the American Railway Association.

Mr. Frank S. Gannon, general superintendent of the Staten Island Rapid Transit Railroad for the last eight years, has been raised a notch, and is now general manager. The property is difficult to manage, and its successful operation has depended greatly upon the tact, judgment and personal popularity of the man in charge. Those who know Mr. Gannon are aware that he possesses these attributes in a preeminent degree. He is an Erie graduate, and tells many interesting anecdotes about the methods of Erie operating thirty years ago. He rose through the train service, and was superintendent of the New York & Northern before going to the company he is now with.

Mr. Robert Quayle, master mechanic of the Chicago & Northwestern at Kaukauna, Wis., has been appointed superintendent of motive power and machinery of that road, with headquarters at Chicago. Mr. Quayle has spent the greater part of his working life in the employ of the Chicago & Northwestern. He was for some years foreman of the machine shop of the car department at Chicago, and was promoted from there to be master mechanic at Clinton, Ia. From there he was appointed superintendent of motive power of the Milwaukee, Lake Shore & Western. Here he made the tests of locomotives on rollers which attracted so much attention at the last Master Mechanics' Convention.

Mr. W. H. Truesdale, third vice-president of the Chicago, Rock Island & Pacific, has assumed the duties of general manager, to succeed Mr. E. St. John, resigned. Mr. Truesdale, who was president and receiver of the Minneapolis & St. Louis for many years, was chosen third vice-president of the C., R. I. & P. several months ago. That distinction was earned through his admirable management of a road that was intensely poor—always on the verge of insolvency, which he held off, when most other men would have failed. Mr. Truesdale was one of the most popular railroad men in the Northwest, and his personal popularity brought a great deal of business to the road.

We regret to learn from a dispatch from Cripple Creek, Col., that Mr. Richard Newell, Jr., engineer of the Midland Terminal Railroad, was murdered by a miner with whom he had a dispute concerning right of way. We knew Mr. Newell as a bright engineer some years ago in the Lake Shore & Michigan Southern shops at Elkhart, Ind. He took a very keen interest in all motive power problems, and repeatedly gave us information which he had collected about the performance of the locomotives on the road where he was employed. He was a sunny, genial young man with lots of friends, who will be deeply pained to hear of his untimely end. He was a nephew of the late President Newell of the L. S. & M. S.

Improvements in locomotive fireboxes have been patented by Mr. Joseph J. Bohner, of Brooklyn, who proposes to put an extra water tube boiler inside of the firebox. He puts in a water arch of the ordinary form, except that a space to be filled with brick is left between the arch and the tube plate. This brick can be removed when any work has to be done on the boiler tubes. The novelty of the invention is that 72 water tubes are led from the top of the water table to the back sheet of the firebox. The gases of combustion have to pass through this barrier of water tubes before entering the boiler tubes, which ought to make a valuable addition to the heating surface of the firebox. The arrangement is also calculated to be a good preventer of spark throwing.

Mr. William Smith, who has been superintendent of motive power and machinery of the Chicago & Northwestern since October, 1890, has resigned that position. He has been connected with the mechanical department of the C. & N. W. since 1873, and previous to 1890 was for three years assistant superintendent of motive power. From May, 1885, to August, 1887, he was master mechanic of the Winona & St. Peter and Dakota divisions. Mr. Smith was trained as a marine engineer, and was for years on the Cunard Company's steamers trading between Liverpool and New York. As a railroad man he was particularly successful as a shop manager. His department, while head of the motive power of the C. & N. W., was run at lower expense than that of any railroad in the West.

At this season of the year good resolutions are in order. In the department of railroad equipment a seasonable resolution would be not to cast invidious reflections upon railroad officers because they specify the other fellow's goods. It is right and proper that the men in charge of rolling stock should have preferences in the articles they specify. A man is lacking in individuality if he has not. The preference generally represents his judgment of what he considers best. Sometimes he thinks two rival articles are about equal, and if the price cuts no figure he probably permits friendship for some dealer to influence his decision. Those who get left are too ready to attribute bad motives as the cause of their failure. No better resolution could be taken at the New Year than to resolve to overcome this attribute of smallness.

The Elements of Boiler-Making.

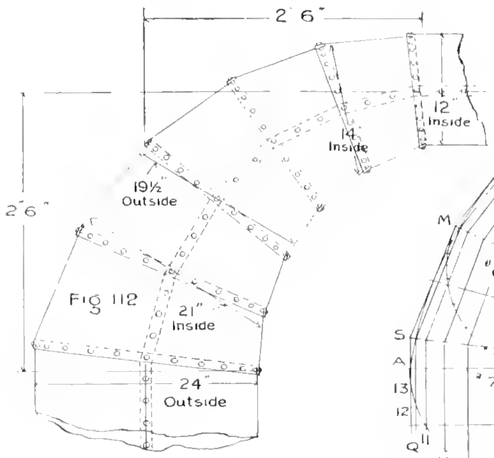
SHEET-IRON WORK.

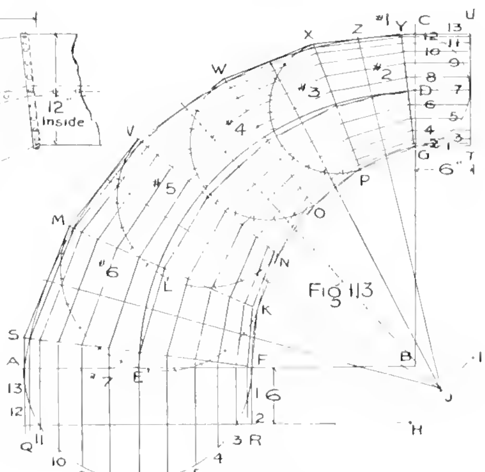
By C. E. Fourness.*

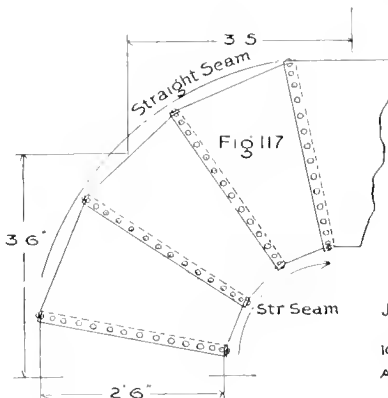
ELBOWS.

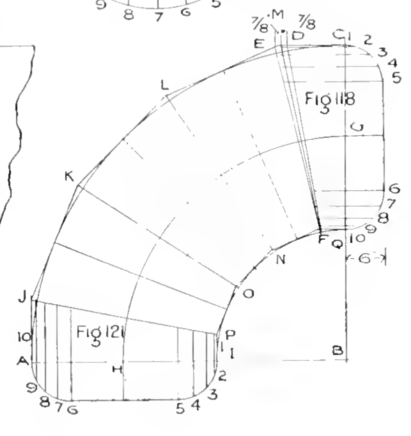
In this article will be given a tapering elbow to connect two pipes, one 24 inches in diameter, the other 12 inches. The material to be No. 10 B. W. G. in thickness, and the elbow to compose of five courses or sections. Fig. 112 is a side elevation of the elbow complete and shows the location of the seams and the general appearance, but is not needed to lay out the sheets. The outline view, Fig. 113, is the one needed for this purpose, and in drawing this view, the first lines drawn will be *A B* and *B C* at right angles to each other. Then set the trams to the distance 2 feet 6 inches and draw the center line or arc *D E*. As the diameter of the large pipe is 24 inches, set the dividers to the radius 12 inches, and from the center *E* draw the semi-circle *A F*. Again, as the small pipe is 12 inches in diameter, set the dividers to the radius or 6 inches, and from the center *D* draw the semi-circle *C G*. Set the trams from *A* to *B*, and with this length draw the arc *H*; set one leg again at *C*, and draw another small arc cutting the first arc at *H*. Then with one leg of the trams at the point of intersection *H*, draw the arc *A C* for the outside of the elbow. Set the trams from *G* to *B*, and with one leg at *G* draw the arc at *I*. Set one leg at *F* and draw another short arc to cut the first arc drawn. Then from the point *I* draw the arc *F G*, space off this last arc for as many courses or sections as you may wish the elbow to be made up of; in this case it is five. Set one end of a straight edge at *J* (a point midway between *I* and *H* on a straight line), the other part to *F*, *K*, *N*, *O*, *P* and *G* successively, the points of division just found on the arc *F G*, and draw the lines for the girt or round-about seams.

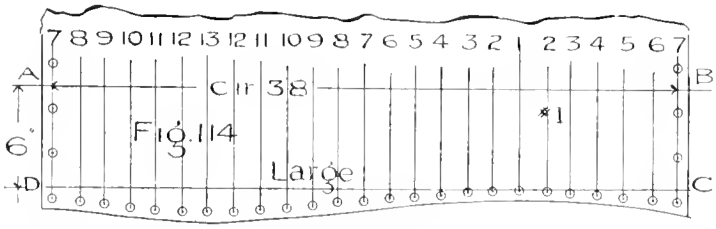
Find the center of the different courses between the lines for the girt seams, and draw the lines to terminate at the center *J*; these lines are needed to measure the lengths of the ordinates. Draw the lines *S A Q* and *F R* at right angles to *A B*; then *F K*, *K N*, *N O*, *O P* and *P G*; these lines, to terminate at the point where the arc *F G* cuts the lines for the rivet holes *G T* and *C U*, are drawn at right angles to *B C*. Now for the outside, draw *S M* between the lines for the rivet holes from *S* tangent to the arc *A C* to *M*; then from *M* tangent to the arc to the next line *V* draw *V W*, *W X* and *X Y* in a similar manner and the outline is complete. Now for the ordinates, set one leg of the dividers at *L*, the point midway between *M* and *K*, and draw the semi-circle *M K*. Set the dividers at the point midway between *V* and *N*, and draw the semi-circle *V N*. Draw the semi-circles *W O* and *X P* in the same manner, and, after this is completed, space off each semi-circle in thirteen points, and draw the ordinates through the semi-circle *A F* at right angles to the diameter *A F* and just cutting the line *S F*; number these ordinates from 1 to 13, beginning with No. 1 at *F*. Draw the ordinates through the semi-circle *C G* at right angles to *C G*, just cutting the line *G Y*; num-

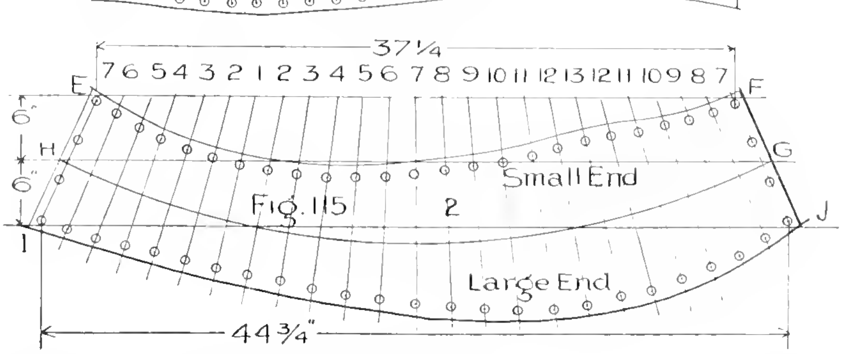












ber them from 1 to 13, beginning with No. 1 at *G*. In this elbow each section must be laid out separately, as no two are similar, consequently the ordinates must be drawn through each and every section. So start with the section *X Y G P*, by laying the square along and up to the line *X P*, the blade to the point No. 12 on the semi-circle *X P*; make a short mark across the line or diameter *X P*, move the square along the line *X P* till the blade comes in line with the point No. 11, then draw a short mark across the line *X P*.

Proceed in the same manner until all the points are marked on the line *X P*, then move to the lines *W O*, *V N* and *M K*. Mark them in the same manner until the marks are found on all these lines, after which continue the ordinates already drawn through each section until all are drawn. Next draw two lines *Q R* and *U T*, 6 inches from and parallel to the lines *A F* and *C G*, from which to measure the length of the ordinates. Now for the sheets, and

* Foreman Boiler-maker, C., M. & St. P. Ry., Dubuque, Iowa.

start with Fig. 114; this will be a square course 12 inches inside. First find the circumference, $12 \times 3\frac{1}{7} = 37\frac{5}{8}$ and $37\frac{5}{8} + \frac{3}{8} = 38$ inches. Draw two lines $A\ B$ and $C\ D$, 6 inches apart and parallel to each other. Then draw two lines for straight seams at right angles to $A\ B$ and 38 inches apart, space off the line $A\ B$ for twenty-four holes, and draw lines through these points parallel to the straight seams, and as these straight seams are to be located on the sides, number the ordinates, beginning at B, with Nos. 7, 6, 5, 4, 3, 2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 12, 11, 10, 9, 8, 7. The length of the No. 1 ordinate is already found; measure the length of the ordinate No. 2, between the lines $G\ Y$ and $U\ T$, Fig. 113, and mark this length on the lines No. 2 in Fig. 114. Measure the length of the ordinate No. 3 in Fig. 113, between the lines $G\ Y$ and $U\ T$; convey this length to Fig. 114, and mark this length upon the line No. 3, measuring from the line $A\ B$; convey the lengths of all the ordinates in the course, Fig. 113, to the similarly numbered lines in Fig. 114, and the point of intersection of these marks with the lines will be the center of the rivet holes in the girt seam. Space off the straight seams for any number of holes needed, and after allowing $\frac{1}{2}$ inch for lap outside of the holes Fig. 114 will be complete.

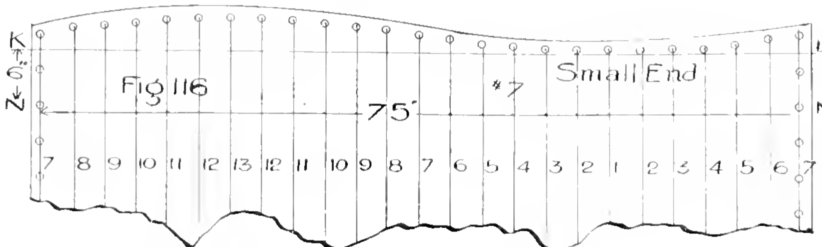
Now for the course No. 2, Fig. 115. Draw three lines, $E\ F$, $G\ H$ and $I\ J$, 6 inches apart and parallel to each other, and the next thing necessary is the circumference; the small end is 12 inches in diameter, and the circumference of that is $37\frac{5}{8} - \frac{3}{8} = 37\frac{1}{4}$ inches, the circumference for an outside diameter of 12 inches; this length lay off on the line $E\ F$, and from a point midway of this length draw a center line at right angles to $E\ F$. To find the diameter of the large end of this No. 2 course, measure across at the lap hole at right angles to the No. 7 ordinate or straight seam, and find the diameter is 14 inches, $14 \times 3\frac{1}{7} = 44$, and as this is the large end, $44 + \frac{3}{8} = 44\frac{3}{8}$ inches; this length lay off on the line $I\ J$, an equal amount, $22\frac{3}{16}$ inches, each side of the center line. Draw a line through I and E, extending it far enough to cut the center line; then draw another line through $J\ F$, extending far enough to cut the line $I\ E$, and at this point or vertex set one point of the trams with the other point at G; where the line of the straight seam cuts the center line draw the arc $G\ H$. Space off the circumference at each end for twenty-four holes and number them, beginning with No. 7 at F, as the straight seams are to be located on opposite sides in adjoining courses or sections, 7, 6, 5, 4, 3, 2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 12, 11, 10, 9, 8, 7; draw lines through the correspondingly numbered points on the lines $E\ F$ and $I\ J$. Measure the length of the ordinate No. 1 between the center line $J\ Z$ and $G\ Y$, the line of rivet holes; mark this length on the radial line No. 1 at the small end of the No. 2 section, Fig. 115, measuring from the arc $G\ H$. Mark the length of all the ordinates between the lines $J\ Z$ and $Y\ G$, Fig. 113, on the radial lines at the small end of the section No. 2, and these points will be the center of the rivet holes at that end.

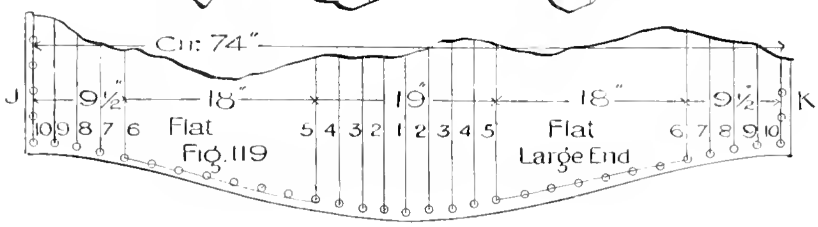
For the large end measure the lengths of all the ordinates between the center line $Z\ J$ and $X\ P$, the line of rivet holes, and convey these lengths to the large end of the section No. 2; these points will be the center of the rivet holes at that end. Space off the straight seam for two holes, exclusive of the lap holes, and after allowing one half inch outside of the rivet holes for a lap the sheet is finished. The sections Nos. 3, 4, 5 and 6 are each laid out separately and exactly the same as the No. 2, only, of course, using the proper circumference for each end. But there is no excuse for not having every rivet hole needed in this elbow before rolling up.

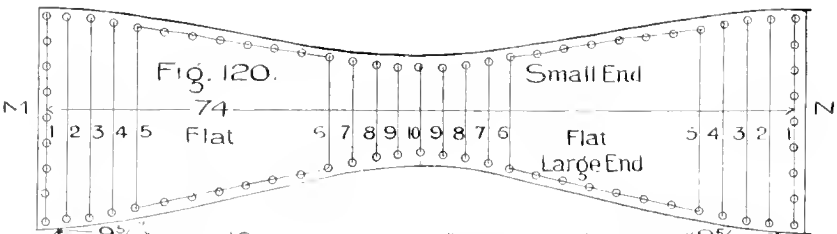
Draw two lines, 6 inches apart and parallel to each other, for the No. 7 course. This course is 24 inches in diameter outside; $24 \times 3\frac{1}{7} = 75\frac{3}{8} - \frac{3}{8} = 75$ inches, the circumference. This length lay off on these lines and draw lines for the straight seams through these points at right angles to those already drawn. Space off this circumference for 24 holes and draw lines through all these points, parallel to the straight seams. Number these lines 7, 6, 5, 4, 3, 2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 12, 11, 10, 9, 8, 7, beginning at the right side. This brings the straight seam on the same side as in the course No. 1. Measure the lengths of the ordinates between the lines $Q\ R$ and $S\ F$, Fig. 113, and transfer these lengths to the similarly numbered lines in the course No. 7. Space off the straight seams and allow one half inch for lap all around, and this sheet is ready to shear and punch.

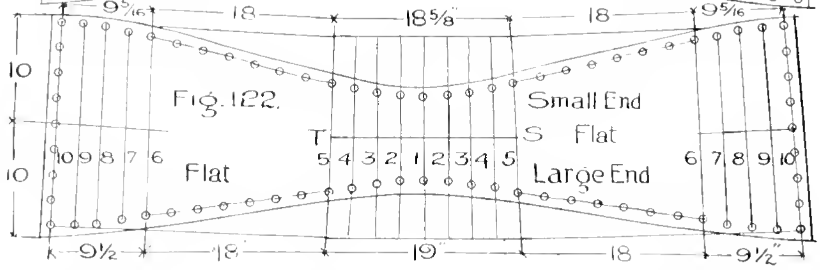
AN OVAL ELBOW.

Fig. 117 is an elevation of an oval elbow 2 feet 6 inches, or 30 inches long and 12 inches wide. This is also made of No. 10 material. This is made necessary by the chimney being at the side of the boiler and having an oval opening on top of the smokebox. In this case the straight seams will be placed on the curved sides, or the inside and outside, and they (the sections) will be laid out by two different methods, Figs. 118 and 121. But first the outline view is to be constructed: Draw the lines $A\ B$ and $B\ C$ at right angles to each other, open the dividers or trams to 36 inches, and draw the center line $G\ H$; mark the points A and I 15 inches on either side of H. Set the trams from A to B, and draw the arc $A\ C$; set the trams to $B\ I$, and draw the arc $I\ Q$; space off the arc $H\ G$ into eight parts, and J, K, L and M will represent the line of rivet holes. Draw $A\ J$ and $I\ P$ at right angles to $A\ B$









and $E C$, and $F Q$ at right angles to $B C$; draw the other lines forming the outline $J K$, $K L$ and $L M$ to connect these points and tangent to the arc $A C$; also connect the inside points similar to the others. Set the dividers to 6 inches, one-half the diameter of the oval, and from a point 6 inches from A, I, Q and C draw the quarter circles or quadrants, and through these points, 6 inches from Q and C, draw lines parallel to $E C$, and through the points 6 inches from A and I draw lines parallel to $A J$. Space these quadrants into 5 points, number them as shown and draw ordinates through these points parallel to the sides of the figure.

For the sheets, Fig. 118 will be considered first, and is the same method shown in the last paper on elbows, the course being laid out square, and the large and small ends are secured by increasing the angle of the girt seam for the large, and decreasing it for the small end. Draw a line for the length of the ordinates for the large end from E 7/8 of an inch from M to F, and for the small end draw a line from D 7/8 of an inch from M to F. (The distance to set these lines over for different thicknesses of material is: for No. 16, 3/4 inch; for No. 8, 1 inch; for 1/4 inch, 1 3/8 inches, and for 5/16 inch, 2 inches.) In this case, thickness is between Nos. 16 and 8, so will call it 7/8 inch.

Now for the courses or sections, Figs. 119 and 120, and the first thing required is the circumference, which we have already, as this will be 12 inches in diameter inside, same as Fig. 114. This length is 38 inches, and as each flat side is 18 inches long, and there being two sides, add two times 18 inches, or 36 inches, to the 38 inches for the full circumference—this equals 74 inches; draw two lines $J K$, Fig. 119, and $M N$, Fig. 120, and lay off 74 inches on these lines. Draw lines for the straight seams at these points at right angles to $J K$ and $M N$. Draw a center line midway of the length, or 37 inches from and parallel to the lines for the straight seams. Divide the circumference of the 12 inches, viz., 38 inches, into fourths—this equals 9 1/2 inches; this distance measure off on each side of the center line in both sections. This gives twice that amount, or 19 inches, one-half of the circumference, to roll here. Also make a mark 9 1/2 inches from the straight seams at each end and space off each of the spaces into 4 parts or 5 points, draw lines through these points and number them in Fig. 119, beginning with No. 10 at the straight seam, as it is located on the short side, and ending with No. 1 at the middle. In Fig. 120 start with No. 1 at the straight seam and end with No. 10 at the middle. Now for the girt seams, measure the length of the ordinate No. 1 between the lines $C Q$ and $E F$ in Fig. 118, and as this is for the large end mark this length on the lines No. 1 at the end intended for the large end of both Figs. 119 and 120, measuring from the lines $J K$ and $M N$. Measure the length of the ordinate No. 2 between the lines $C Q$ and $E F$ in Fig. 118, and mark this length on the lines No. 2 at the large end of Figs. 119 and 120; proceed in the same manner until the lengths of all the ordinates between these lines have been transferred to the large end, then draw lines from the points just found on the Nos. 5 and 6 lines and space off these flat spaces for 6 holes, and after this being done the large end is all finished.

For the small end, measure the length of the ordinate No. 1, Fig. 118, between the lines $D F$ and $C Q$. Convey this length to the lines No. 1 at the small end of Fig. 120. Again, measure the length of the ordinate No. 2 between the lines $D F$ and $C Q$, Fig. 118, and convey this length to the lines No. 2, Fig. 120. Transfer the lengths of all the other ordinates in Fig. 118 to the lines similarly numbered in Fig. 120, after which draw straight lines from the marks on the Nos. 5 and 6 lines across the part to remain flat, and space them off for six holes. This completes this figure, and, after allowing the necessary lap, these sheets can be used for a pattern to mark off the other sections needed. Next in order comes the everyday method, Fig. 121.

In this way the courses can be made either square or taper (but if made square, the small course must set inside of the large course at both ends), and in either case the flat part is left the full length and the reduction for the small end of the course, or the small course is made in the circular parts at the ends. The course or section, Fig. 122, is made taper, and to lay out this piece start by drawing three lines $O R$, $T S$ and $P Q$, 10 inches apart and parallel to each other; measure off on the bottom line $P Q$ 19 inches for the curved part at the large end, and 9 1/2 inches from each end draw a center line at right angles to the others. Then on each side of this center line on $O R$, the line for the small end, lay off 9 5/16 inches; this will give this part a total length of 18 5/8 inches. Draw lines through $O P$ and $R Q$; draw $R V$ and $Q V$ at right angles to $R Q$; then $O X$ and $P W$ at right angles to $O P$; 18 inches from O, P, Q and R, make a mark for the termination of the flat sides, and allow 9 5/16 inches more to X and V on the lines $O X$ and $R V$; also allow 9 1/2 inches to W and V on $P W$ and $Q V$. Draw the lines for the straight seams and space off these parts, to be curved into four parts, the center one into eight parts; and draw lines through these points of division, and a center line midway between $X W$ and $V V$ at right angles to the line No. 6. Find the camber, as shown, and measure from these points in transferring the lengths of the ordinates between the lines $J P$ and $A I$ from Fig. 121 to the correspondingly numbered lines in Fig. 122, marking the same at both the large and small ends of the sheet, and these points of intersection will be the center of the rivet holes in the girt seams at the curved part. For the flat sides, space off same as in Fig. 120.

To Prevent Dimming of Cab Windows.

Every man who has run a locomotive in winter understands the annoyance and danger endured in cold weather by the cab windows getting clouded over through frost and condensed steam. The Tinker Storm Window Co., of Springfield, Mass., have put upon the market a storm window which keeps the outlook transparent at all times.

The improvement consists in attaching to the inside of a regular cab door a specially designed window so constructed as to form a water-tight space about 5/8 inch in width between the two panes of glass, which space is filled with water, or, if preferred, any other suitable transparent liquid. The water is heated to a sufficient temperature to warm the glass sufficiently so that the snow, ice, frost, etc., will not adhere to its surface, thus providing a clear glass in front of the engineer during the worst storm or coldest weather. The necessary warmth is imparted to the water by means of a heated tube between the glasses, this tube being heated by a small jet of steam passing through it.

Windows of this kind were in use on locomotives belonging to the Concord & Montreal and the Boston & Maine railroads, last winter, and are reported to have proved a complete remedy for the obscuring of the cab windows.

A Big Supply Man Reckoned as a Half Person.

They appear to have curious methods of estimating charges for passengers in some parts of Europe, one of which was described by Mr. W. W. Snow, in the account of his travels in Norway. He said:

I started out to arrange our trip to the North Cape to see the midnight sun. At the office of the Dampskibselskabs (who control a large portion of the mail steamships in Norway) I was accosted by a very genteel young man, who, in broken English, asked my wishes. I handed him the letter given us at buyers' office in Bergen. He then asked me how many. I said:

"Two ladies and myself."

"Wife one?"

"No; daughter and one other."

"Other lady not your family?"

"No."

"Ah, if wife and daughter, one fare and two half fares; yourself, daughter and other lady, two full fares and one half fare."

So we found our party consisted of "two and one-half persons" in Norway, it being the custom on Norway steamers to charge half fare to wife and children. While this condition of things was permitted as a paying basis on the steamer, for the trip to the North Cape, we wish it to be distinctly understood that this one-half person was a big majority over the other two and fully vouched for by all on board.

PRACTICAL LETTERS FROM PRACTICAL MEN

Babbitt for Taking Up Side Play in Driving Boxes.

Editors:

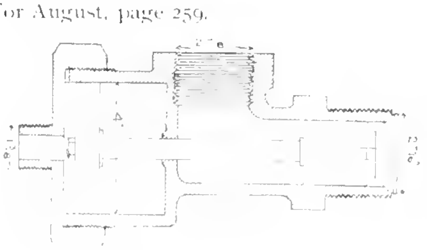
Referring to your article, page 391, December issue, "Excessive Wear Caused by Babbitt," and with special reference to Mr. Smith's remarks on its use for taking up lateral motion, I wish to say that I have been using babbitt for this purpose for twelve years and do not recall a single instance where the hubs of driving wheels showed excessive wear. On the other hand, I have known engines to be turned out without babbitt, and it became necessary to drop the wheels and spot the faces of the boxes with babbitt in less than a month to stop them from cutting. In March, 1890, led by some remarks of a gentleman who did not favor the use of babbitt in this way, I recorded the distance between the hubs of the back wheels of an eight-wheel engine, the boxes of which were faced with the metal, and again measured the distance between these hubs when the wheels were taken out, after the engine had run 81,357 miles, and found it had only increased $\frac{1}{32}$ of an inch. This engine made 322 miles each round trip, without cleaning, over a sand-ballasted road, and wore out two sets of crown bearings in the back boxes while making the mileage given. This record, I think, speaks well for babbitt as a preventive of wear of hubs.

Pensacola, Fla. C. F. GILES, M. M.

A New Blow-Off Valve.

Editors:

Enclosed herewith I send you a sketch of a blow-off valve that I consider an improvement on the Preston blow-off cock illustrated in LOCOMOTIVE ENGINEERING for August, page 259.



The valve, in its present form, is liable to stop up with sediment in the space between the top of valve and end of case projecting into boiler; this sediment would become solid, making it impossible to raise valve off its seat.

In the sketch enclosed the valve is inside-closing, the valve stem or wings are notched deep close to disk as a weakening groove; in case valve body is broken off, stem is likely to break at that point, leaving the opening closed.

If you consider the idea, as expressed in the sketch, of any value, or that it really is an improvement, publish it. I give it simply as my idea of an improvement in that line; would be pleased to have your opinion of it and any improvement that you would suggest.

Derry, Pa. D. B. DONNELLY.

What Caused the Air Whistle to Sound?

Editors:

I would like to ask the air-brake readers of LOCOMOTIVE ENGINEERING to assist us in solving the following little difficulty we have met in with an air signal. On one of our engines the whistle sounds every few minutes when the engine is moved slowly, but when engine is coupled up to train and running either fast or slow, whistle never sounds except when signal valve is operated in coaches in usual manner. Application or release of air brakes does not affect the whistle, it simply sounds of its own accord. We found reducing valve, whistle valve and all pipes and connections apparently in proper condition.

C. C. LEECH,
Gen. Foreman W. N. Y. & P.

Buffalo, N. Y.

Location of Block Signals.

Editors:

I read with interest your article on above, and wish to say that the practice in force years ago—according, as you say, to a well-known English railway engineer—of putting signals here, there and everywhere, some on the wrong side of line and others where they could not be seen, has long been abandoned, and at present, in fact for years past, an intelligent system of signal sighting has been in force on the L. & Y. W. Railway, for which company I worked as fitter (machinist) and locomotive foreman for fifteen and a half years. The practice in vogue on this road is as follows: If a signal is defective, worn out, or complaints are made as to its unsuitable position by engine drivers or, in fact, anyone making use of it, a meeting is convened by order of the signal, locomotive and traffic superintendents, of the following persons:

First—The locomotive foreman, who sights the signal in the interest of the engine drivers and obtains for them the best view on proper side of line (where possible) and with the best background (a most important thing).

Second—The traffic inspector, who arranges that the signalman when operating signal can see that it responds to the movements of his lever.

Third—The signal inspector, whose duty it is to see that when signal is placed in position it can be satisfactorily worked and suitably arranged. When the height, position and distance from signal box are determined, a form is filled out giving all these particulars, and this is signed by afore-mentioned men and sent to signal superintendent, who gives an order for signal to be erected. By these means the best results are obtained, and a smart locomotive man can arrange a good signal for the enginemen which, if on a falling grade, can be seen long before there is any necessity to apply brakes. Of course, on a rising grade, a shorter sight of it would be sufficient. The "home and starting signal" shown in your excellent view of Penmaenmawr in last month's issue was sighted by me in the manner described above.

H. T. BENTLEY,
Roundhouse Foreman.

Boone, Ia.

Keeping Bad Feed Water in Working Order.

Editors:

Having read your valuable journal for the past three years, and having been much pleased with the manner in which the subjects pertaining to engineering have been handled, I thought I would venture to give my experience in using bad feed water in locomotives. Having been in charge of locomotive repairs for the past seven years on the Dakota division of the Chicago & Northwestern Railway, where we have about as bad water for locomotive use as there is in the United States, I thought perhaps I might be able to describe what it contains, also how it acts in the boiler and how we get along with it. The following is an analysis of water taken from one of the water tanks on this division:

	Grs. per gal.
Total solid matter	129.75
This solid matter consists of:	
Carbonate of lime	10.66
Carbonate of magnesia	1.44
Sulphate of lime	11.92
Sulphate of magnesia	12.21
Oxides of iron and aluminum	0.19
Silica	0.35
Alkali chlorides	14.06
Alkali sulphates	78.92

For the benefit of those who do not un-

derstand this analysis, will say that it is very bad water for locomotive use, and that when an engine takes a tank of this water it will not go 5 miles with a heavy train before the flues and staybolts are leaking, even though the flues have just been reset.

The leaking of the flues and staybolts is caused by the water's foaming so badly, and, unless the engine is equipped with a first-class blow-off cock, and the blow-off cock properly handled, the train will have to be reduced or, as has often happened, set out altogether. In order to get a train over the road with this kind of feed water, it is necessary to have a blow-off cock that can be opened quickly by the engineer, for the reason that the throttle must be closed for about one minute while the blow-off cock is being used, as the solutions that cause foaming can only be blown off successively at this time. In fact, it is the only time to use the blow-off cock to a good advantage, as all of the troublesome qualities of the water go to the hottest place in the boiler, and when the engine is working hard they are all mixed up with the water, and as soon as the throttle is closed they settle around the firebox sheets, and some of it fastens itself to them and the rest of it is ready to keep the water foaming as soon as the throttle is again opened. But if the engine is equipped with a blow-off cock that can be opened and closed by the engineer, as he does the air brake, then he will blow out so much of this foul matter that when he opens the throttle again the water will be clear in the glass, and he will get along all right until he reaches the next station, where the same performance must be gone through with again, and so on through the whole trip.

Now I think I can see the engineer smile and say: "What does he take us for, anyway? If he thinks we are going to open such a blow-off cock as most of the engines are equipped with in this country every time the throttle is shut off for a station, he is very much mistaken, as that can't be done, as most of them leak all the time, anyway, and when they have just been opened then they are in bad shape for the rest of the trip." Well, there is no one that knows this better than I do, for after taking care of these old blow-off cocks for the last twenty years, I don't think I am far out of the way in saying that up to within the last year they have been the poorest thing on the engine; but during the last year there has been a blow-off cock invented by Mr. Wm. McIntosh which is operated by compressed air, which fills the bill. There are seven of these air blow-off cocks in use every day on this division, and they work to perfection; and for the last six months it has not cost as much to keep these seven air blow-off cocks in repair as it has to keep one of the old-style plug blow-off cocks in working order, besides the inconvenience of having them leak all the time.

I presume some one will say, Why don't you use some good compound that will keep this bad water from foaming, as there are a number of good compounds that will keep water from foaming? Let me say to any such person that all of the compounds that can be thought of have been tried on this division, and with very poor success; while some of them would help a little, they were very expensive, and not nearly as effective as a blow-off cock that can be operated at all.

The exchanging of ideas as we get them from LOCOMOTIVE ENGINEERING has been very helpful to me, and I am always ready to take up with a good suggestion, and if there is any one who knows of any better method of handling bad feed water I should like to hear from him through the columns of this paper, so that all of the readers can have the benefit of it, and I will say in conclusion that if I survive this effort you will hear from me again on this subject.

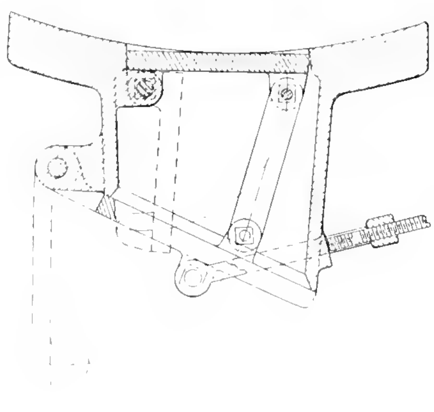
F. M. DEAN,
General Foreman,
Dak. Div. C. & N. W. Ry.

Huron, S. Dak.

Improved Cinder Valve.

Editors:

We send you herewith a drawing of an improved extension front hopper which may be of some interest. The usual style



of hopper now in use consists of a hollow cylindrical casting or pipe with a flange, and is riveted to the bottom of the smokebox. These hoppers are continually cracking, and make quite an item of expense in locomotive repairs, the cracking being caused by excessive heating on the inside, due to the presence of red hot cinders and extreme cold on the outside, which is exposed to the outer air. The improvement, designed to overcome this defect, consists of hinging an inner lid to a lug at the top of the pipe, this lid being connected to the bottom one by means of a cast-iron link. The dotted lines show the positions of the lids when open.

The exclusion of cinders from the pipe will also, we think, preserve the air-tight joint between the outer lid and the casting.

J. W. JAMES,
C. K. SHELBY.

Altoona, Pa.

Misleading Reports on Defects of Brakes—Limited Knowledge of Brakes and High Pretensions.

Editors:

The inconvenience in locating the trouble and correcting defects in the air-brake system was very nicely shown by Mr. Conger in the November issue, and has been the subject of former letters to this paper from other correspondents. Too much cannot be said. An engineer's report must, of necessity, be clear enough to give the repairmen some correct ideas to work on, but reports that refer to any unusual trouble are usually obscure in meaning. The trouble occurs on the road; the repairmen are confined to the shops; the traveling engineer or air-brake superintendent was not on the train when the brakes acted badly, and, of course, the engineer's report is the only thing to rely upon as an accurate definition of the trouble.

One reason for the making of many mysterious reports is, that engineers are rather disposed to think that they understand the air-brake thoroughly after they have passed through a little "side show" of an examination by some lesser official who does not understand it himself and wants to get rid of the examinee as quickly as possible. This one reason exemplifies the old saw, that "a *little* learning is a dangerous thing."

If an engineer *is* thorough on the air and possessed of clear judgment, his reported work is a snap for the repairmen; but if he is not very well posted, yet has sense enough to know it and admit it, it will not be difficult to work on his reports, because he will state plain facts and nothing imaginary; he will not alter the case to suit the circumstance, as he thinks it is.

"A *little* learning is an *expensive* thing" might be a better adaptation for railroad use. When a man masters one or two of the illustrations in the instruction book—the ones that he considers of most importance—he is satisfied that he is the best informed man on the air on the road, and when any puzzling question regarding the action of air brakes arises he is ready with an answer.

The other day an engineer, who admits that he knows all about the air, had some trouble with his brakes. I don't think that he made a regular report, but he told some of us fellows about it. He had a full freight train, eight cars, engine and tender working air. Engine and tender brakes connected separately with train pipe. There was a three-way cock instead of an engineer's brake valve, but otherwise the engine equipment was Westinghouse standard. His statement was, that at the first telegraph station there was a red signal out, showing that there were orders for him, and when he tried to make a very light brake application to just close the slack of the train, the black hand of gauge went back 20 pounds and stood there, and

the brakes went on at emergency. Stopped a little too soon, and the conductor, with blood in his eye, came limping down to the office to sign the order, and remonstrated loudly with the engineer as to his manner of applying the brakes on a train but partly equipped with air. The engineer tried to explain how it happened, but they went out and carefully inspected the air-braked cars and found no leaks or other apparent defect. The engineer further stated, to prove there was no air leakage, that after releasing the brakes the pump had no trouble in quickly restoring the pressure, and would maintain it, working slowly. When the diaphragm valve in the pump governor raised, it was held up half a minute before the pump would start again, and then only a few strokes and the governor would close it off. This would prove that there was no leakage of air. Well, the conductor rode on the engine until the next stop was made, and there the three-way cock was put on lap and no air exhausted; the brakes went on at emergency and the black hand of the gauge dropped back 20 pounds instantly.

It was that way all the rest of the trip. Lapping the three-way cock would send the brakes on full, and the black gauge pointer would go back a distance of twenty pounds. When the trip was ended, and the brakeman closed the angle cock at rear of tender to cut off from the train, the brakes did not apply, but it ought to have had the same effect as lapping the three-way cock. The engineer shut off his pump ten minutes before leaving the engine, and in that time the air gauge showed no leakage. The three-way cock and everything else about the engine was perfectly tight.

This incident is generally accepted as stated, and is regarded as something mysterious, but I think it was reported incorrectly. His knowledge and his imagination got mixed a little. I leave this to the readers. Such odd reports are not made any oftener by young engineers than by the old-timers, although the air brake is more of a complication now than ever. A few years ago a passenger engineer was regarded with veneration and awe by the lesser lights of the craft, on account of his supposed expertness in air-brake practice. There wasn't so much of it to learn those days, it was plain automatic; but if a passenger engineer wanted to lay off, an extra or freight engineer was never sent out on the run, because he "didn't understand the automatic." The passenger engineers had to "double" for each other, and a good scheme, too—financially.

Nowadays freight engineers and the older firemen are able to pass examinations on the air that would be denounced by those old-timers as unnecessarily severe, and it wouldn't be out of place to give an example or two here as to what those old-timers, with the air-brake halo about their heads, did know of the "automatic."

I was firing a big passenger engine one day, on a fast run, with a train of nine cars; and approaching a railroad crossing, the signal was suddenly and unexpectedly turned against us and a train on the other road allowed to cross before us. We had good brakes and made a good stop, but the engineer's face was paler than usual and his voice trembled a little when he said to me: "Suppose one of the air hose in our train had bursted just as I went to make that stop, what would have become of this train?"

Another engineer was making a downhill stop at a flag station, and a heavy freight train was heading in at the further end of the siding, just beyond the station platform, when he lost the use of his driver brakes. The piston-rod packing nut at one side had worked loose and dropped, and the cup leather blew out. When he heard the noise of escaping air, he reversed and used sand, but passed the station and went over the frog at the switch, barely missing the steps of the caboose as it turned in to clear. Of course, there was no report to be made; such things occur frequently; but he explained to his conductor, and to the crew of the freight train later: "Didn't have an ounce of air in the train; driver-brake piston packing blew out and let all the air out of the train from end to end." No one dared to take exception to his statement, and he was complimented for making so quick a stop with the reverse lever.

One night our engine burst her train-brake pipe between the three-way cock and hose connection to tender. It was very foggy, and necessary that the train air signal should be operative so as to give warning to us if the train should break in two, as well as to transmit signals from the conductor; but the engineer shut off his pump, and had to be told that by putting the three-way cock on lap there would be no loss of air and the signal line would work all right.

WILL W. WOOD.

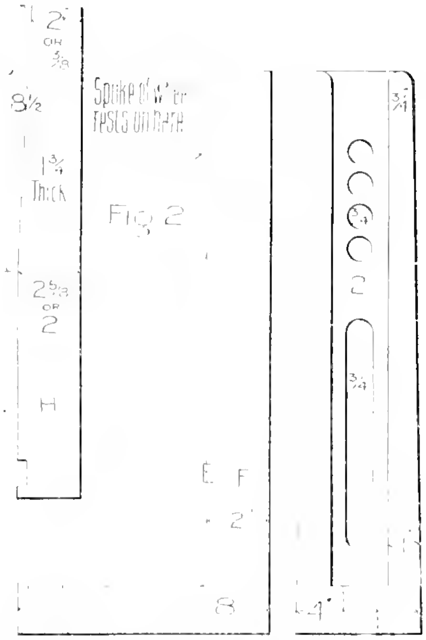
Terre Haute, Ind.

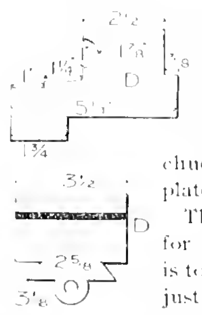
Some Wheel Lathe Tools.

Editors:

One of the reasons why a boring mill is liked by some to do large work on in preference to the face plate of a lathe, is that when it is on, it cannot fall any further. But if large lathes had the same facilities for holding work such as chucks and drivers, I think that there are lots of jobs that could be done better on them than on the boring mill. There are not many railroad repair shops but bore their own tires, also bore and turn wheel centers and front end plates on the wheel lathe, and how many are provided with good chucks for holding the same? If the lathe has none, then the machinist is not to blame for having a preference for the boring mill.

The chuck, Fig. 1, and driver, Fig. 2, we have used to advantage. They are easily made and answer all purposes, and are perfectly reliable. The piece *A*, Fig. 1, is of cast iron and shows the plan, and *B*, Fig. 1, shows end view. The projection on back is to fit into slot on plate; it is secured by two ⅞-inch bolts. To keep from slipping, have a piece forged size of slot and drill full of holes, so that the bolts which hold chuck on will go through them. The screw is square thread, six to the inch. The jaws are made of soft steel, *D*, Fig. 1. They are planed to fit the chuck and tapered for screw. They should be central, so as to be reversible; the outside is finished in place. The groove is to hold flange of tire while boring, and without





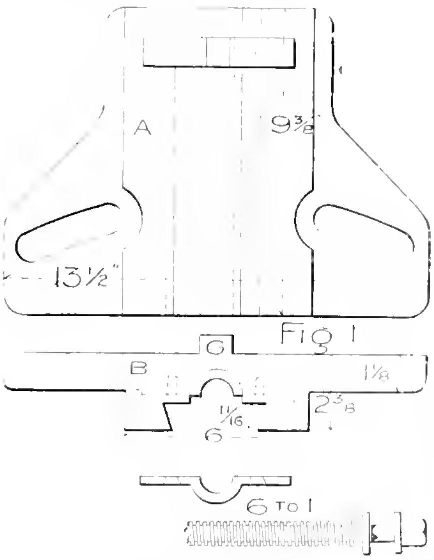
shifting, a cut can be taken from outside so as to size tire. One or two steps can be turned on and several sets of jaws can be made. There should be three of these chucks for each face plate.

The driver, Fig. 2, is for driving wheels and is to allow for ready adjustment, as if all drivers do not have the same tension on the spoke of the wheel there will be a good deal of chatter at the tools, and if the cut is not steady a good job cannot be done.

The drivers are made of cast iron—one is made thick, as shown by dotted line *E*; the rest thin, line *F*. On double-headed lathe we use four drivers. They are planed on end that fastens to face plate, and four holes drilled for 1-inch bolts; several holes are drilled at outer end of thick one, and this one is put on first and bolted to spoke. For the others we have two sets of wedges *H*, Fig. 2; these are made of wrought

iron. Instead of a number of holes, as in the first driver, we have a long slot at inside end; then when driver is bolted to plate, draw out wedge until it is hard against the spoke; do the same on the other face plate and all will drive even.

There are other drivers that are as good as these, but these are easily made, and, being of cast iron, are cheap and do the work just right on our old lathe, which is single, and the pin goes through face plate. We use old engine truck jaws; but on the double lathe they are not long enough. We have a Niles double lathe on which



we changed the feed, which would be of interest to those that have one, but as all do not have I will reserve it.

W. A. ROBERTSON.

Cedar Rapids.

Death Roll of Last Year.

There has been a great deal of agitation within the last few years in favor of the introduction of safety appliances that would reduce the dangers of railway operating, and much has been done for the preservation of life and limb, but the Interstate Commerce Commission Report just issued shows that the death-roll continues to be frightfully large.

The number of railway employés killed during the year covered by this report was 2,727, being greater by 173 than those killed during the previous year. The number of employés injured was 31,729, being greater by 3,462 than the number injured the previous year. The increase in the number of employés during the year was 52,187. The number of passengers killed during the year was 299, being less by 77 than the number killed the previous year, and the number injured was 3,229, being 2 in excess of the number injured the previous year.

The total number of passengers carried was 593,560,612 in 1893, as against 560,958,211 in 1892, being an increase of 32,602,401. Under the heading "Other Persons" is included a statement of the number of persons killed and injured by railway accidents who, at the time of the casualty, were neither employés nor passengers. It includes casualties at stations, highway crossings, and to trespassers upon tracks.

The total number of deaths during the year on account of accidents to persons of this class, in connection with railways, was 4,320, and the total number injured was 5,435.

What's in a Name?

Jim Blair and Dick Scott got orders to change engines, and Jim's fireman made up his mind to change seat cushions—Dick's decided that it was all wrong.

They "got together" in the tank, and all hands had to be piped to quell the mutiny. When the melée was over, Scott's man had a lump on his head about the size of a goose egg—then all hands were ordered to the master mechanic's office.

"Good Lord, man, have ye got a wen commin' on ye?" asked the old man, with concern, as Scotty took off his cap.

"No, sir; that chaw on the '319' hit me with a hammer!"

"McCormick," said the old man, severely, "did you hit that man with a hammer?"

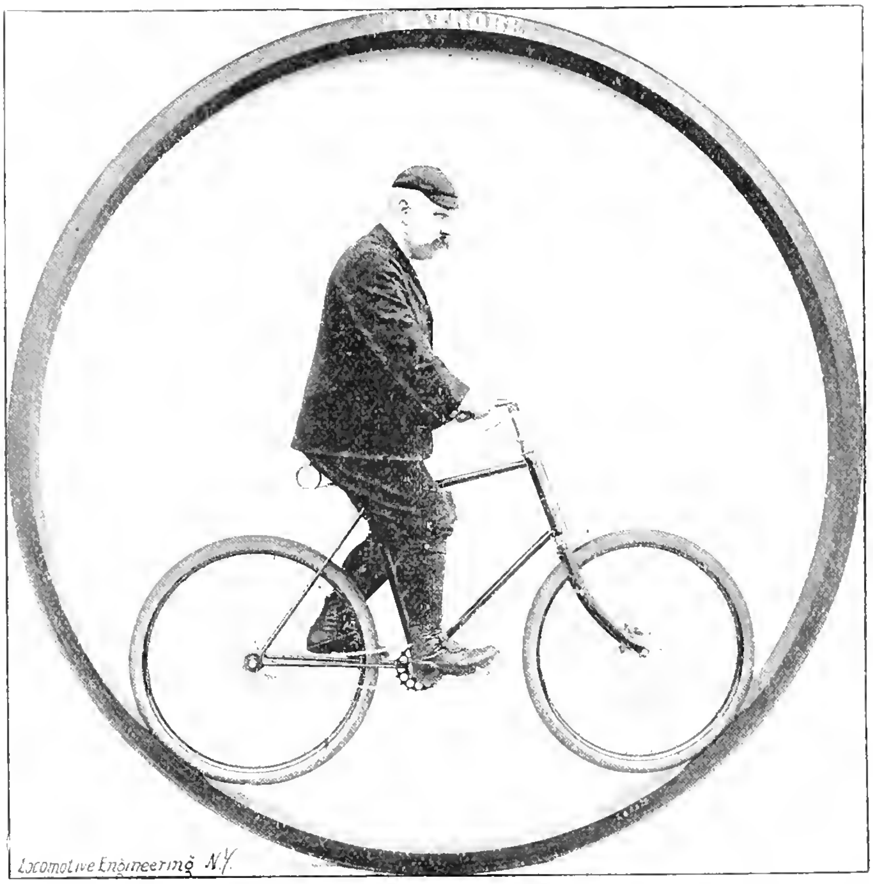
"Oi did, sorr—but, your honor, it wor wid der saft hammer; I wouldn't hit a fellow mortal wid an iron hammer! Sure, sorr; I kin prove it wor the saft wan—phy, if I meant harm to him, I'd a' tuck der coal pick, bedad!"

Largest Steel Tire Ever Rolled in America.

The Latrobe Steel Works recently rolled a tire 101 inches outside diameter, 6 inches wide and 3 inches thick.

Some idea of the size of this ring of steel may be had by a glance at the picture. Here the tire is used as a frame for a full length equestrian portrait of the handsome treasurer of the Latrobe Co.

This tire was not rolled to order, and there is no intention that we know of, of building a record breaker with a 101-inch leg. The question arose: "What is the capacity of the works in point of size of tire?" and the practical men at the head of affairs found out by trying, instead of figuring on it.

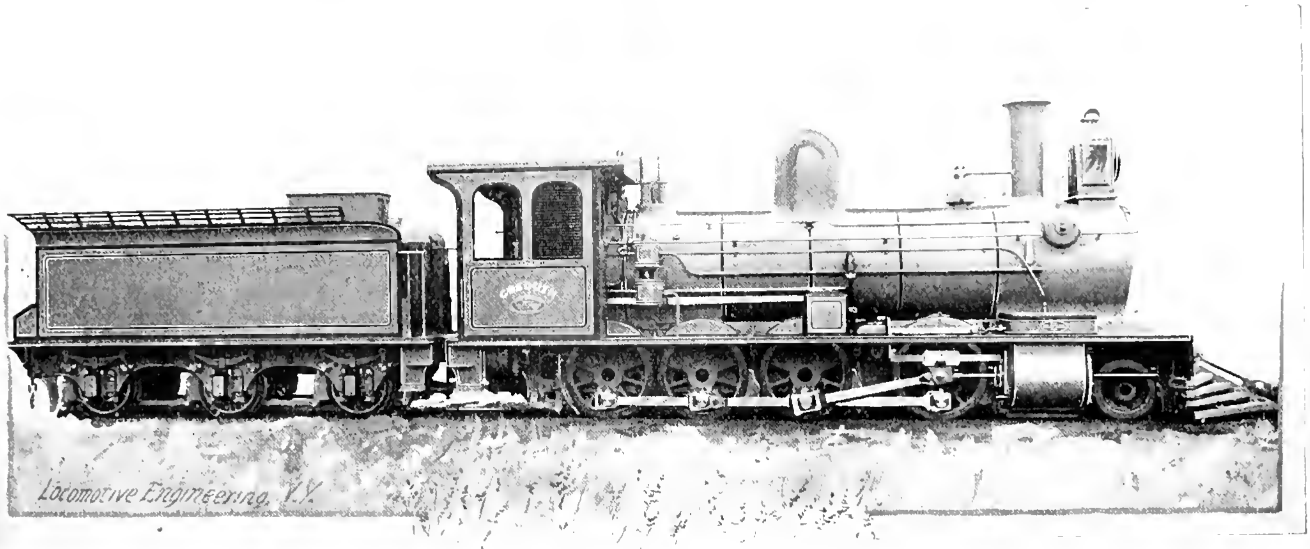


A rival to the skipper who stood on the burning deck, is an engineer who performed a great deed of heroism at Wilkesbarre, Pa., one day last month. James Lloyd is engineer of the hoisting apparatus of the Stevens colliery. The house in which the machinery is located took fire, and there was imminent danger of the whole thing being burned up and the miners below, forty-six in number, being left below to be drowned. The engineer realized the danger and signaled the men to get up. He stood there with the flames around him and brought up three cage loads of men. The building collapsed and fell around the engineer before the work of rescue was finished. He was badly burned, but is likely to recover.

Easy Magic.

Jones, of the Missouri Pacific, is a joker, and makes fun sometimes that is not relished all round. The chief of the division was anxious to have a big meeting last month, and happening to mention this to Jones, the latter offered to perform some feats of magic to attract the boys. Word was sent around, and, sure enough, there was a crowd in attendance. After the business of the meeting was over, Jones was called upon to bring out his magic. As a beginning he took up his dinner bucket and drew a package containing a sandwich out of his pocket. "Now, boys," he said, "you watch this. I'll turn this sandwich into something else. See, now," he said, taking up the sandwich and dropping it into the dinner bucket, "you see I've turned that sandwich into a dinner bucket."

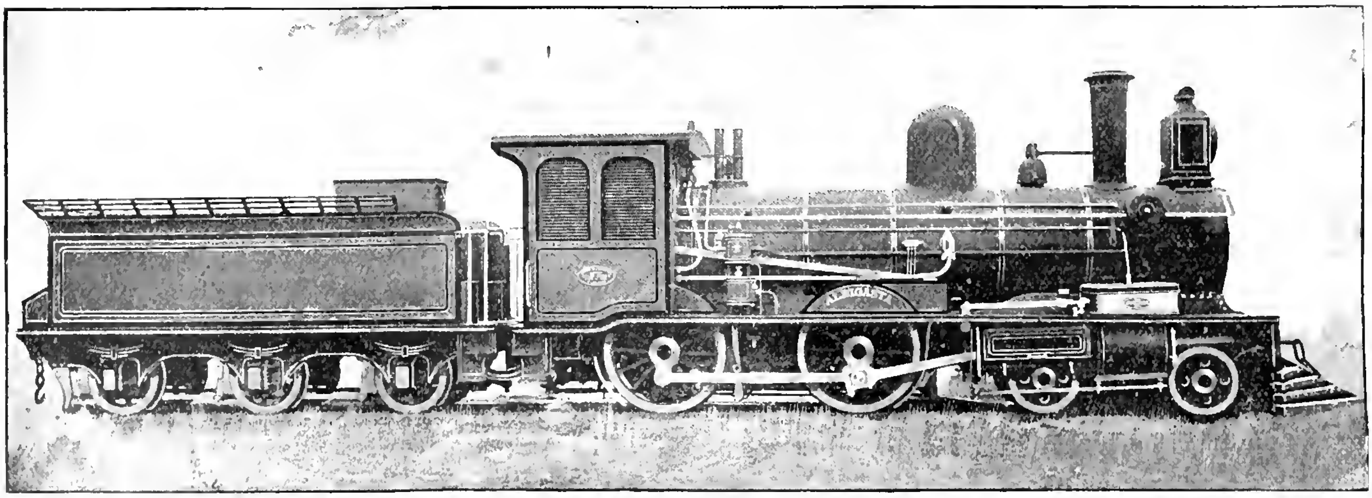
"Now, boys," he proceeded, "I shall show you another ——" but before he could proceed to the next trick there were so many mallets, inkstands, and other minor articles of hall furniture flying towards his head that he hurried out without giving the parting sign to the chief.



The Thurman Fuel Oil Burner Co., of Indianapolis, Ind., are putting on the market a device for kindling locomotive fires with oil. They use buried oil tanks and all piping is under ground, an oil hydrant being located between every other pit. The apparatus, it is claimed, kindles 500 pounds of coal with one gallon of oil in from three to five minutes, and, by leaving the burner in, raises steam enough to move engine in 35 minutes.

The passenger department of the Cincinnati, Hamilton & Dayton, which is always doing something original to attract the attention of travelers, has lately issued what they call a "chap book." The writer remembers when chap books formed the principal popular reading in Scotland. They consisted of collections of short stories, and were sold by "chapmen," who were traveling peddlers. Burns speaks about the hour "when chapmen billies leave the street." The Cincinnati, Hamilton & Dayton chap book must have been got up by one familiar with the old Scotch forms. It is printed on hand-finished paper, with ragged edges, and abounds in odd conceits. Any one can have it by applying to the C., H. & D. chap book department, Carew Building, Cincinnati, O., and enclosing 5 cents in stamps.

We are informed by Mr. George H. Lloyd, of Boston, that our list of locomotives built by Edward Bury & Co. for American railroads was not complete. He says there were certainly two engines built by this firm for the Boston & Providence road, on which they ran for many years. They were altered over into coal burners early in the 60's and used quite successfully to run in light suburban trains.



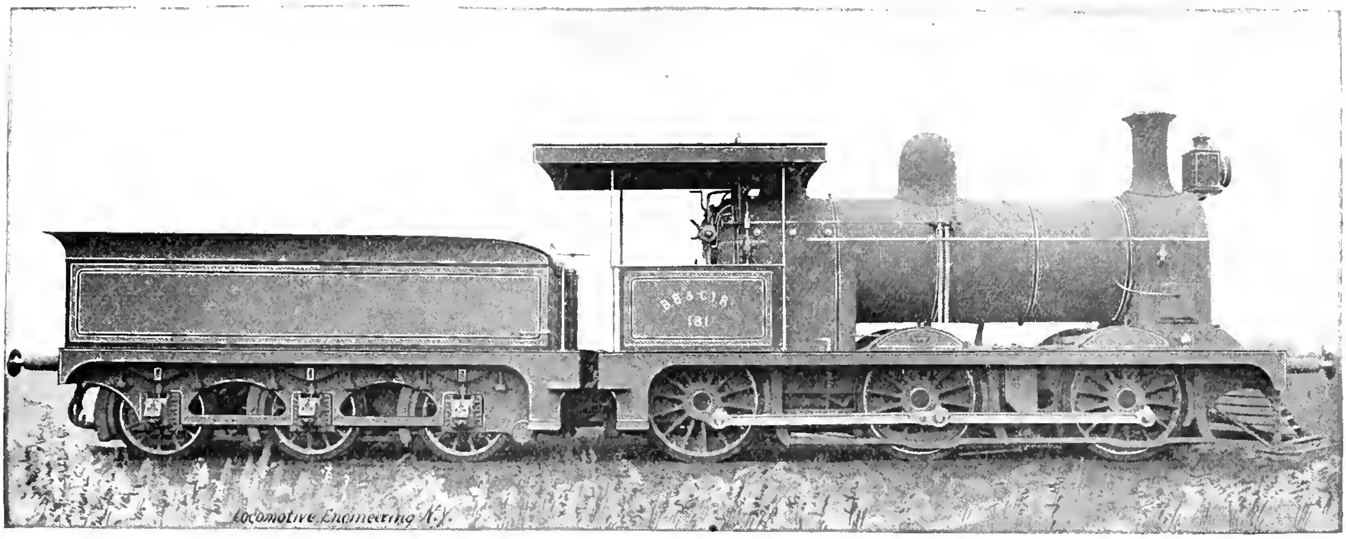
General Master Mechanic R. M. Galbraith, of the Cotton Belt road, recently raised locomotive "No. 132" from under twelve feet of quicksand in the bed of the Red River, at Garland City, Ark., where she had rested since August 6, 1887. The machinery of the engine is reported to have been in good shape, the paint little the worse for its long bath. The engineer's silver watch was found in the seat box, and it is said that after the application of new hands and a new dial it will run again.

Some Foreign Compounds.

We show herewith three engravings of compound locomotives of the two-cylinder type, recently built by Neilsons, of Glasgow.

The first picture shows a compound freight engine for the Bombay, Baroda & Central India Ry. This engine has a high-pressure cylinder 19 x 26 inches, a low-pressure 27 x 26 inches, wheels 4 feet $7\frac{1}{2}$ inches in diameter and a wheel-base of 15 feet $7\frac{1}{2}$ inches.

There are 1076.08 square feet of heating surface, of which 92.43 are in the firebox.



The engine weighs 90,000 pounds, the tender capacity being 2,000 gallons. The other two engines, which were built for roads in Argentina, S. A., have a gauge of one meter.

The dimensions of the consolidation engine are as follows:

Cylinder, one high-pressure, 16 x 24 in.
Cylinder, one low-pressure, 23 x 24 in.
Coupled wheels, 3 ft. 6 in. diameter.
Truck wheels, 2 ft. 3 in.
Wheel base, fixed, 12 ft. 7 in., total 19 ft. 2 in.
Heating surface, tubes, 845.5 sq. ft.
Heating surface, firebox, 92.25.
Weight in service, 90,000 pounds; 82,800 on the coupled wheels.
Capacity of tender, 1,980 gallons.

The dimensions of the eight-wheeler are as follows:

Cylinders, high-pressure, 15 x 22 in.
Cylinders, low-pressure, $21\frac{1}{2}$ x 22 in.
Coupled wheels, 4 ft. 6 in. diameter.
Bogie wheels, 2 ft. 6 in. diameter.
Heating surface, tubes, 742 sq. ft.
Heating surface, firebox, 76 sq. ft.
Weight in service, 83,000 pounds, 49,280 pounds of which are on the coupled wheels.
Tender capacity, 1,760 gallons.

The Nicholson File Company, of Providence, R. I., are designing and preparing for publication the handsomest and most artistic catalogue ever gotten up by a file manufactory. It will be issued early in the year, and users of files in railway shops who desire a copy should send their addresses in at an early date.

It took over eight tons of paper to print the January issne of LOCOMOTIVE ENGINEERING. If the paper were spread out flat, it would cover $26\frac{9}{16}$ acres of ground. If the pages were laid down side by side it would make a paper sidewalk 157 miles long. One hundred and seventy-five pounds of ink were used on the edition. The paper alone cost over $1,000; the engravings upward of $500. Some people can't understand why we can get 25,000 railroad men to pay $2.00 per year for LOCOMOTIVE ENGINEERING, and we publish this as a hint—perhaps the practice of giving full valne for the money has something to do with it.

Three circulars have been issued last month by committees of the Master Mechanics' Association, calling for information on which to base reports. One is from the Committee on Cause of Bulging of Firebox Sheets, one on Riveted Joints and the other on the Best Material for Boiler Tubes. They are all very good circulars and ought to bring out full information on the subjects under investigation. We again urge upon those concerned to send in replies as promptly as possible.

The Brotherhood of Locomotive Engineers of the Canadian Pacific have an article of agreement in their schedule which requires the company to select all men for the position of master mechanic from locomotive engineers employed upon the road. Mr. T. G. Shaughnessy, vice-president of the company, is said to have expressed himself very favorably to this part of the agreement.

The officials of the French Republic appear always to be ready to honor the heroes of industry with distinctions that formerly were given exclusively to the fighting and ruling classes. The latest example is the making a Chevalier of the Legion of Honor of a locomotive engineer named Desbord, who distinguished himself in a railroad accident.

The Ewald Iron Company, St. Louis, Mo., in view of the freqnent inquiries for a hexagon-shaped iron for railroad purposes, are manufacturing at their mills, in Lonisville, Ky., regularly, all sizes hexagon bar iron from $\frac{5}{8}$ to $1\frac{3}{4}$ inch diameter.

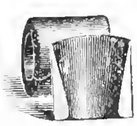
On December 10, Engineer A. R. Johnston, of the Wheeling & Lake Erie, was leaning out of his cab window to watch something on his engine when he was struck by the bridge over the river just west of Warrenton, O., and was instantly killed.

The Detroit Metallic Packing.

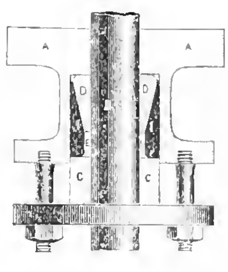
The engravings shown herewith will make plain the details of construction of a simple form of metallic packing that is made and sold by the Detroit Lubricator Co., Detroit, Mich.

It has quite an extended use on stationary engines, and some sets are running on locomotives. It was a set of this packing that ran in a valve stem on a freight engine on the I. & I. S., for six and a half years without repairs, mentioned in this paper last March.

The metallic cone is made in two pieces, as shown herewith, and can be applied without removing the rod. This cone is also shown at *D D*, in large cut.



Around this cone is an elastic cushion, shown at *I I*. The smallest part of this cushion is larger than the rod, and between it and the rod a slight wind of hemp is used.



The ordinary gland is employed, and when the packing blows a little it is taken up by tightening the gland. No springs of any kind are used.

Those interested should address the makers.

The Home of Locomotive Engineering.

Not every reader of this paper can "drop in" on us—the drop is too far. But every interested reader of a paper has a feeling of partial proprietorship or something akin to a brotherly interest in everything that concerns his favorite paper.

We are a little stuck up about our new quarters; perhaps most of this comes because the old home was so small and inconvenient. We know our readers would like to "take a peek" into the place, anp therefore show some pictures of it made direct from photographs.

You understand that the office is on the fifteenth floor of the Home Life Insurance Building, on Broadway, and directly opposite the City Hall and the New York entrance to the Brooklyn Bridge.

The four windows in the main office look out on the city from Chambers street, toward the northeast. The four windows of the private sanctums look out over the roofs of six and seven story buildings and across the North River (Hudson), toward Jersey City and Hoboken.

Up this great waterway all the European steamers come and go, a sort of a perpetual dress parade for our benefit. When the photographer located his "gun," the White Star steamer *Majestic* and the Cunarder *Lucania* were broadside on in the stream, but by the time he got ready they were gone and the stream as bare of floating palaces as a duckpond. This view was taken out of the window of Mr. Hill's private office.

Private Office of Angus Sinclair

Main Office, Looking from Private Offices.

The general arrangement of the main office, as seen from the entrance door, is shown on this page.

On the cabinet (for drawings) in the center of the room can be seen the mailing lists, where the names of the sanctified are recorded.

The mailing room is fitted with shelving for holding copies of the paper, stationery, etc. Only the transient mail is handled here. The regular mail amounts to some tons, and is sent to the Post Office direct by trucks from the bindery on William street, where the paper is wrapped. Our engraver, Mr. Donnell, occupies one end of the mailing room, where he has a good light and is "far from the madding crowd."

All the furniture in the offices is finished in oak, and every modern convenience is had for the correct and expeditious execution of the work in hand. The detail of work connected with the mailing list can be guessed from the size of the list and the fact that from November to April, last year, there was an average of *over 200 letters per day* concerning additions, corrections and changes in the list.

Above this picture is a snap shot taken of the Junior Philosopher while sawing wood. The capacious waste basket, while empty now, is oft full to overflowing, as the Senior Philosopher is rather tender-hearted; he often sits in judgment and then comes in with a tired air and puts a screed before the Junior Philosopher with the remark: "It's not worth a cuss, John." The Junior Philosopher acts as executioner.

On page 30 is a view of the main

PRIVATE OFFICE OF JOHN A. HILL.

MAIN OFFICE, FROM ENTRANCE, LOOKING TOWARDS MAILING ROOM.

office, as seen from the private offices, and above is a side view of the S. P. tapping his think tank.

The owners of LOCOMOTIVE ENGINEERING think that there is nothing too good for the readers of the paper—they try to make it the best thing going—and believe that their employés can do their work to the best advantage in nice surroundings.

There is an old-time belief that a newspaper office should be about as neat and clean as a shoemaker's shop. This office is furnished as comfortably as a home. The hardwood floors are covered with rugs; there are no unsightly piles of exchanges, waste paper or old boots around, and it is kept clean because it is clean.

We don't publish this to brag, but to let our friends know how we are situated and what we are doing.

LOCOMOTIVE ENGINEERING was established seven years ago; its aim has always been to teach mechanics to railroad men, and to be a medium for the exchange of ideas for those in charge of shop and road work—a practical help. On those lines it built its foundation and placed its faith, on those lines it has won a place up near the front of the procession, and this is due in a large measure to its readers; they have helped and encouraged it, pointed out its shortcomings to its editors and recommended its merits to their friends.

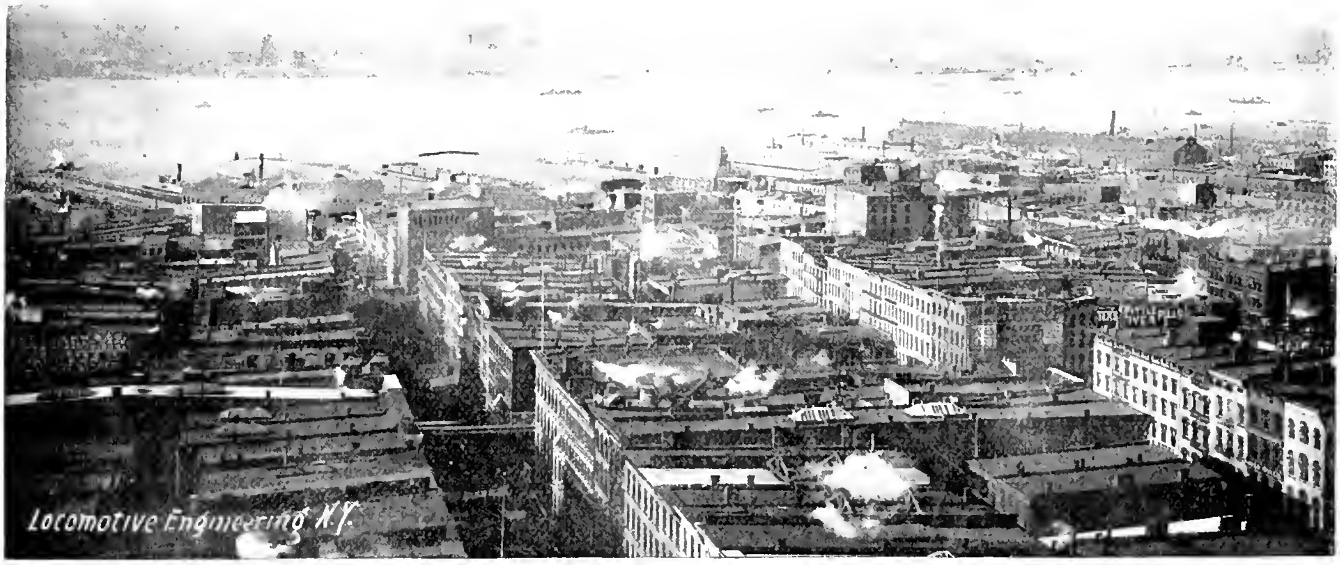
On the first day of 1895 the paper counts more friends and more acquaintances than ever on her visiting list, and feels now as if she was just getting into society.

Every day that a newspaper lives gives it more opportunities to improve; it soon has the choice of matter from the best writers, pictures and kinks and suggestions drop in from far and near, and if good use of these opportunities are not made it's clearly the fault of the man at the editorial rudder.

The pilots of this boat feel sure of the course laid out, and an abiding faith that they can get into port monthly, fog or no fog. They are saturated with something of the same kind of conceit possessed by a very young pilot who boarded a big liner to bring her into port; the captain was a little skeptical of his abilities on account of his age.

"Young man," said he, "do you know where all these rocks are?"

"No, sir," was the prompt answer, "I don't, *but I know where they ain't!*" Which is the all-important point?



VIEW FROM OFFICE OF LOCOMOTIVE ENGINEERING, LOOKING ACROSS THE NORTH RIVER, JERSEY CITY IN THE DISTANCE.

Bad Valve Setting.

"Dutch" Usick was looking his mogul over at the coal chute track in a tired way, when "Elder" Luddington stopped his mill behind "Dutch's" old pelter.

"Goot morning, Mister Luddingdon, vos you in on dime dis morning?"

"Yes, Brother Usick, and a fine morning it is, too; an ideal spring day, Brother Usick. The little blades of grass are peeping through the earth, the birds are singing and the sun is shining—just seems to me every one of 'em is thanking the Lord that it is morning and spring."

"Yah, I subbose dey is gladt dey vos alife—I'd feel almost like dot myself ober it vosn't for dot fladt spod in der triving veels, andt I —— "

"Do you know," interrupted the "Elder," "that I was thinking last night how every noise was a song of praise if you but hearken to it. Why, sir, I listened to my old engine coming along last night, and she just seemed to me to be singing:

"Praised be the Lord!
Praised be the Lord!
Praised be the Lord!"

"Mister Luddington," said "Dutch," "I doldt you vot is de madder—*her walves is oud!*"

We have lately received from Beaman & Smith, of Providence, R. I., a neat illustrated catalogue showing machinery tools made by the company. They consist mostly of milling, drilling and boring machines, some of them being especially made for locomotive work.

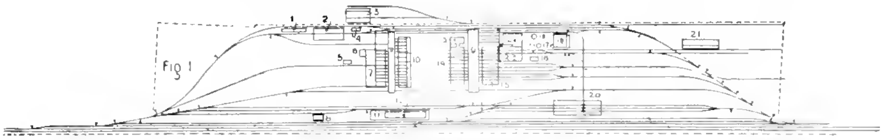
CAR DEPARTMENT.

Conducted by Orville H. Reynolds, M. E.

Edison Car Shops.

In the shadow of old Mt. Tacoma, lying at tide level, is one of nature's garden spots which, unable to resist the encroachments of the corner-lot man and the ever-progressing genius of mechanic arts, has given up a part of its fair domain for the location of one of the model railroad shops of this country.

The plant is about three miles from the city of Tacoma. This explains why we refer to the snow-capped mammoth as above. At Seattle it is Mt. Ranier.



PLAN OF EDISON CAR SHOPS.

1. Coal and iron store house.
2. Blacksmith shop.
3. Foundry.
4. Store house.
5. Lavatory.
6. Engine house.
7. Machine shop.
8. Oil house.
9. Transfer tables.
10. Boiler, tank, tin and copper shops.
11. Platform.
12. Office and store house.
13. Store house.
14. Paint shop.
15. Coach shop.
16. Lavatory.
17. Water tanks.
18. Well.
19. Dry kiln.
20. Freight repair shop.
21. Lumber shed.
22. Boiler house.
23. Wood-working shops.

Surrounded by apparently inexhaustible forests of fir, it would seem that this would be an ideal situation for car building—and so it is, many hopper-bottom coal cars, logging cars, stable cars and box cars having been built here in the three years' life of these shops.

The climate is particularly favorable to out-of-door work—a trifle damp at certain seasons, perhaps, but not disagreeably so, it is said—the equable temperature of the atmosphere making it possible to handle much of the repair work outside, if found necessary by an unusual piling up of "bad orders."

Nestling in its green, velvety setting, on a plateau which required but little labor to prepare it for its gems in brick and steel, is an up-to-date installment that is a credit to its projectors.

The shops comprising this plant are designed to meet not only present needs, but to reach far into the future, and this policy of the builders shines in comparison with that of some others who have builded for to-day only, willing that posterity should kick at their want of forethought or capital.

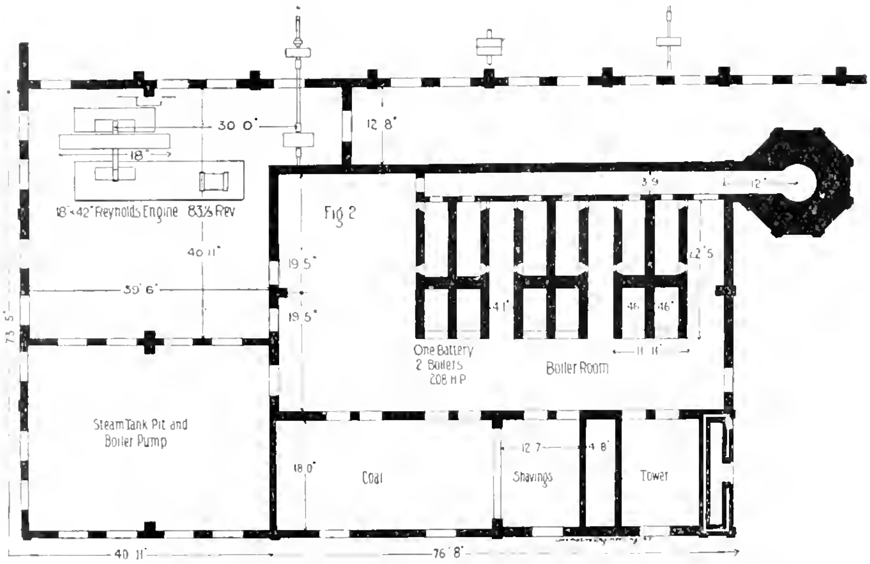
Fig. 1 shows a general plan of the shops—machine shop, blacksmith shop, boiler shop, paint shop, coach-erecting shop and wood-working shop. It is our purpose to describe the car shops only, and we will begin with the engine and boiler rooms, one story, 81 x 117 feet.

An 18 x 42 Reynold-Corliss engine, turning 83 revolutions per minute, drives the line shafting 300 revolutions per minute for the wood tools. It is seen that the saving in wear and tear of belting is recognized in the speed of this shafting.

In addition to the main engine there are two electric light and power engines, dynamos, switch-boards, etc., in the engine room, forming a complete electric plant for all the shops and offices. In the rear of the engine room is found the condensation tanks, fire pumps and feed pumps, together with the air compressors and air storage tanks or reservoirs, the latter for use in testing brakes both in shops and yards.

The floor of this room is 10 or 12 feet lower than that in engine and boiler rooms, giving ample head for all return pipes.

The boiler room, coal bins and shaving tower are reached from both this room and engine room. There are three batteries of Babcock & Wilcox water-tube boilers, 208 horse-power to each battery of two boilers, which are arranged to receive refuse automatically from the shaving tower, by chutes to each fire door, when the accumulations are sufficient to make it an object, and that is to make way with the refuse, not to save fuel—as coal is cheap here at their very doors—the company owning extensive mines of rich bituminous coal.



POWER HOUSE—EDISON CAR SHOPS.

Opening out of the engine room is the wood-working shop 90 x 152 feet, forming an L to the coach shop.

Fig. 3 is plan of this shop with location of tools. The heavier machines are placed so that there shall be no interruption to continued movement of a piece of timber on its way to the erecting shop, after once in the mill and started on its journey towards completion.

The sill dresser stands well out in the shop, leaving room between machine and end wall of shop to handle the long pieces in car framing, such as sills, plates, etc.

To handle more than 40 feet long, a square opening is made through the wall directly in line with the sill dresser, through which the piece operated on is passed from the lumber yard to the machine.

This opening is provided with a neat cast-iron casing and door, a scheme that could be profitably copied in some places we wot of, where the shop doors are opened to an "eager and nipping air" when long pieces are being worked.

The four-roll double cylinder planer (No. 11) is right where it will do the most good, with room for piling the material before and after finishing.

Straight across the shop is the automatic cut-off saw (No. 27), its position giving the operator an opportunity to work to the best possible advantage while it croons its lullaby. Just back of this saw is the endless bed surfacer, a tool always in commission (No. 13).

A little further on, and next to the wall, is an iron-frame Daniels planer (No. 12). Why these planers are always located next or near a wall has never been satisfactorily explained, but it is a fact that they are almost invariably placed in such position.

Nos. 12 and 27 are driven from a countershaft running over and at right angles to the main shaft; this is done to bring the machines lengthwise of the shop. This shaft also drives two knife grinders in the tool room.

Near 12 and 27, grouped so as to drive from one countershaft, are a mortiser and borer (No. 24), automatic car mortiser (No. 26), and a universal ripping and cut-off saw (No. 29).

In line with these machines, and near

the sill dresser, is the vertical car tenoner (No. 22), driven from an extension of the countershaft which transmits power from first to second main-line shafting. Between this tool and the wall is another ripping saw (No. 30).

It is seen that there is plenty of room to comfortably work around these machines. Not far away, and nearer the wall, is a triple drum sander (No. 35), used for smoothing up work rapidly, doing away with much hand manipulation on doors and panels and most of the inside finish of cars, reducing it to a minimum, so that little remains to be done before reaching the painter's hands.

Another automatic cut-off saw (No. 28) is a small one located for the convenient use of the cabinet-makers, pattern-makers and coach-builders.

The blind stile borer (No. 40) is another small tool, but none the less useful in the shown at the left of No. 32. Just beyond is a large molding machine (No. 14), and to the right of this is a small four-side molding machine (No. 15). Like the other tools handling long pieces of material, their location shows the work of a master hand.

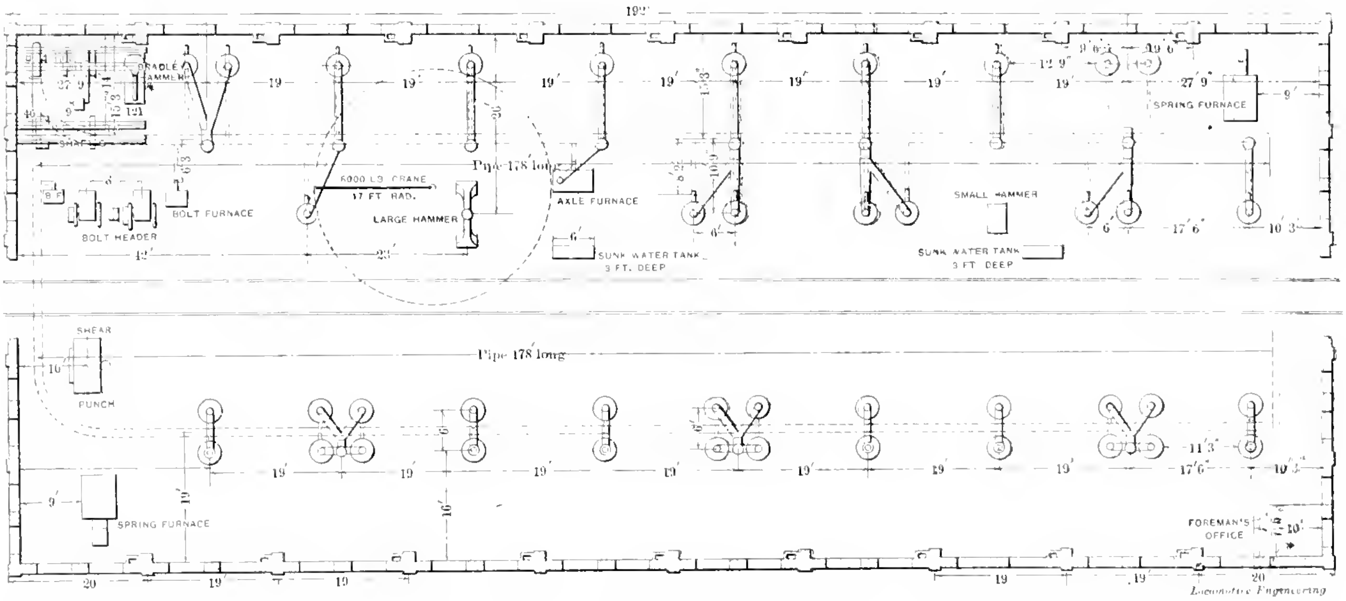
The column jointer (No. 17) is among the last grouping of small tools in this end of the shop. In addition to this is a small scroll saw (No. 33).

A sash and door tenoner (No. 20), Boult's carver and paneling machine (No. 19), a car tenoner (No. 21), and an iron-frame pattern-maker's lathe (No. 36). These comprise the wood-working tools, said, by those who use them, to be most admirably chosen and located.

Up among the flying belts is a pair of large Sturtevant shaving exhaust fans, connected to a suitable system of piping, which extends through the shops above the 35 x 90 feet. Iron doors in the vestibule separate the paint store room from the paint shop. There are ten tracks in this shop also, directly in line with those in the coach shop, separated only by the transfer pit and table.

The structure, 90 x 302 feet, marked "Freight Repair Shop" in Fig. 1, is a building erected for purposes implied in its title, but devoted to the more elevating mission of turning the giants of Washington forests into bright new 60,000-pound freight cars, while the repairs are carried on outside. Three tracks pass through the shop longitudinally, and one transversely, placing it in communication with every shop in the plant.

An elaborate steam heat arrangement is found here, much more complete, in fact, than usually enjoyed in colder climes where the mercury coyly hugs the bulb, and this is a condition, by the way, never



economies of door and sash work. An improved smoothing planer (No. 16) is among this lot of small tools, devoted to the finishing of small work.

Grindstone (No. 45) is driven from the same countershaft with Nos. 40 and 16. This corner looks as though it had been specially designed for the stone.

Out in the center of the shop stands the car gainer and borer (No. 23), facing one of the tracks, ready to bury its polished fangs in its prey of sills, posts, braces needle-beams, carlins, plates, etc., lying on a push car on the track at the front.

A three-spindle vertical borer (No. 31) is at the rear of the gainer, fronting in the opposite direction.

The large car mortiser (No. 25) is shown on the opposite side of track and facing the gainer, ready to perform its functions on the same material sent to the gainer.

At the rear of No. 25 is a single-spindle borer (No. 32), set so as not to interfere with the work handled on the large mortiser.

An edge molder and shaper (No. 18) is machines, supported on the chord of the roof truss. From these main pipes branches drop with easy bends to the different tools, sucking into its never-satisfied maw all sawdust, shavings and chips, and delivering them in a shower to the shaving and dust tower back of the boiler room. These fans serve a double purpose, in removing the debris and furnishing fresh air to the shop.

Referring to Fig. 1, it is seen that the coach shop, 100 x 245 feet, is a part of the wood-working shop, the latter being the annex. The coach shop is two-story, ten tracks passing through it to a transfer table, electrically operated, in a pit 70 feet wide by 400 feet long. The facilities for handling coaches for repairs, or in case of fire, can hardly be excelled.

On the second floor are located the cabinet shop, upholstering shop and pattern shop. Access to these is had by the stairs or elevator shown in Fig. 3.

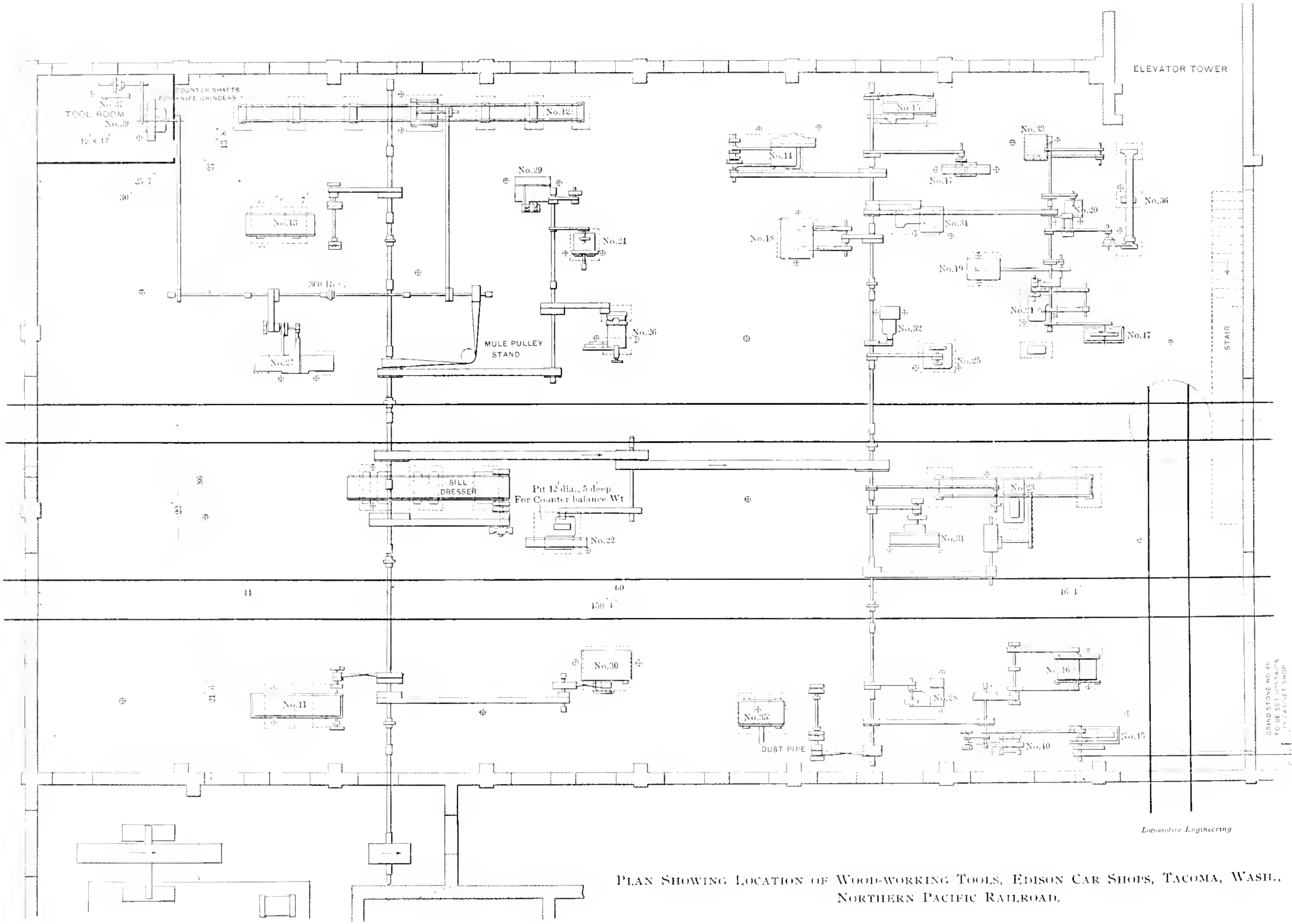
Across from and facing the coach shop is the paint shop, 90 x 242 feet, connecting by a vestibule with the paint store room, yet known on Puget Sound—the home of the octopii.

In the coach shop the steam radiators were placed several feet above the floor, as an experiment, probably, for they are all in their old-fashioned places on the floor in the other shops.

All the shops are liberally lighted with 16 candle-power incandescent lamps—money well spent, a sure dividend earner, for men can work with comfort to themselves and profit to their employers.

The blacksmith shop is 80 x 190 feet, situated at the extreme south end of the plant. Fig. 4 shows in plan the forges and tools, and how the stacks connect with two or more forges in groups and join one common stack before passing through the roof.

A $9\frac{1}{2}$ x 12 Armington & Sims drives the shafting to run the bolt headers, a Bradley hammer and the No. 8 Sturtevant steel blower. This little engine, kept as neat as a piece of silver on the sideboard, would give a twitch at the heartstrings of some people who think anything is good enough for a blacksmith shop.

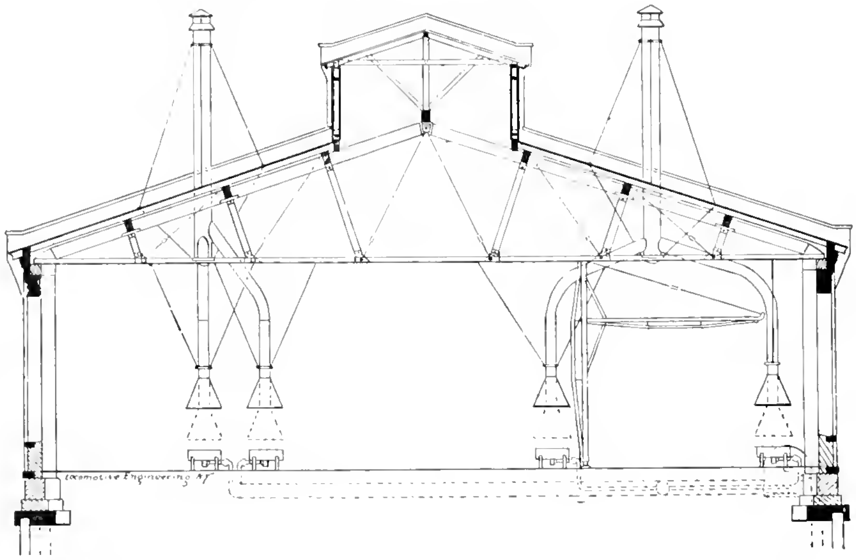


PLAN SHOWING LOCATION OF WOOD-WORKING TOOLS, EDISON CAR SHOPS, TACOMA, WASH., NORTHERN PACIFIC RAILROAD.

An elevation of this shop in section is necessary to clearly show the construction of the smokestacks, the hoods, both raised and lowered, and how supported. This is shown in Fig. 5.

The fan is below floor level a sufficient distance to bring the center of main blast pipe 24 inches down.

Besides the 6,000-pound crane, there are several wall cranes not shown in the engraving. The equipment of labor-saving devices in this new shop would be a revelation to many older ones, where special tools and formers are the exception, and which are too often allowed grudgingly, if at all. The policy of the management is to furnish everything that will cheapen the cost of the output while maintaining its excellence.



Disputes in Car Interchange.

The Arbitration Committee of the Master Car Builders' Association met in Buffalo recently, and decided all the disputed cases which came before them. There were present: G. W. Rhodes, M. M. Martin, J. W. Marden, John Mackenzie and G. L. Potter. They began their proceedings by resolving that no hypothetical case should be considered, and that all cases should be decided under the rules in force at the date of the card.

The Chicago Great Western carded a car for an air hose damaged, and the Winona & Southwestern put on a new hose and charged $1.25. The C. G. W. objected to the price as being too high, and said that they purchased hose for 30 cents a foot. The answer to this was that first-class hose had been used, and the charge represented the actual cost. The Arbitration Committee admitted that hose could be bought all the way from 20 cents to 70 cents a foot, depending upon the quality, but did not think the charge made was beyond the market price for good hose, and so the C. G. W. people were called upon to pay the bill.

The Pittsburgh & Western carded a car belonging to the Philadelphia & Reading for a broken M. C. B. coupler. On account of this card, the P. & R. made a charge of $12.50 for cost of renewal. The P. & W. people held that the makers of the coupler were selling it for $11, and that consequently the charge was too high. The P. & R. replied that the charge was made according to the M. C. B. Rules of Interchange. In this they were sustained by the Arbitration Committee.

The Georgia Pacific performed some work on cars which had been carded by the Illinois Central Railroad. When bills were rendered to the latter company, objections were raised that the charge for labor was excessive. The reply was that the cars had to be repaired some distance from the shops, which increased the expense for labor, and that the charges made were for actual costs incurred. The Illinois Central, however, was not satisfied, and referred the dispute to the Arbitration Committee, which decided that the Georgia Pacific had the right to charge for time properly required to do the work.

The Burlington & Missouri River in Nebraska carded a car controlled by the Cudahy Packing Co. for "one end board broke." When the repairs were done, the packing company added a charge of $2.50 for an inside ice-box cover missing. This charge was contested, on the ground that the cover in question could not be seen by inspectors without raising the outside ice-box cover. They held that such covers come under the rule which puts grain doors at the owner's risk. This view was shared by the Arbitration Committee.

A double-decked stock car belonging to the Chicago, Milwaukee & St. Paul was destroyed on the Fitchburg, and the latter company elected to pay for the car, but objected to a bill rendered which put the original cost of the car considerably higher than the cost of an ordinary stock car. The owners held that the car had the right to be considered under Rule 23 as a special stock car, and therefore of greater value than a common stock car. The Arbitration Committee also took this view, and held that the charge made should be paid.

The Peoria, Decatur & Evansville delivered a car to the Cleveland, Cincinnati, Chicago & St. Louis at Kansas, Ill., and pushed the car upon a Y. The delivering company alleges that on the following day a switch engine belonging to the receiving road went switching the car about the yards and got it off the track, bending some of the axles. The receiving road claimed that the axles were bent before the car was delivered, and that was what caused it to leave the track. The Arbitration Committee held that the receiving road was liable for the bent axles, since it did not exact a card before receiving the car.

The Choctaw Coal & Railway carded an Atchison, Topeka & Santa Fé car for one outside sill and thirteen pieces of siding. The owners, after executing the repairs, rendered bill for $28.67, charging therein for eighty-four pieces of siding and 1½ gallons of paint. The statement was made that it was necessary to tear off the whole of the siding on one side of the car in order to put in a new sill. The other parties do not think this was necessary. In giving the decision, the Arbitration Committee say that it is quite practicable and customary to remove box-car side sills without removing the siding. The A., T. & S. F. people were therefore required to reduce their claims for siding applied to thirteen pieces.

The Lake Shore & Michigan Southern rendered bill against the Jacob Dodd Packing Co. for Janney coupler applied to one of the latter company's cars. The owners insisted that the coupler was too long, and had to be removed; consequently, it was of value only for its weight as scrap. It was also held that the car had only been ten days away from the builders when the new coupler was applied; consequently, it could not have met with fair treatment. The L. S. people answered that the coupler was of the M. C. B. standard length. In the decision rendered, it was held that the Packing Co. should have exacted a defect card when the car was delivered to them if they believed that wrong material was employed.

The Gulf, Colorado & Santa Fé attached cards to cars controlled by the Atchison, Topeka & Santa Fé, because tail bolt instead of pocket drawbar was applied. The carding road was duly charged with the expense of changing the wrong drawbars, but they objected to pay the bill. On the case going to the Arbitration Committee, they held that it had been the policy of the association to provide a wider field in which discarded bars of the link and pin type could be used, so as to foster the introduction of the M. C. B. type of couplers. Through this policy the rules

were changed so that a tail-pin drawbar can be applied without charge to a car which had previously a yoke coupler. On account of this the carding company was not held responsible for the charge made.

The Chicago & Erie carded a car for "one slid flat wheel over 2½ inches," and it fell to the Chicago, Burlington & Quincy to change the wheel. Having no old wheels on hand, they took out the pair where the damaged wheel was and put in a new pair, charging the carding road $8.50. Objection was raised that this was putting betterments upon a car at the expense of the C. & E., and the C., B. & Q. people replied that they could not help that, and that they were merely charging for the expense incurred on account of the wheel receiving damage on the C. & E. The Arbitration Committee sustained the charge made by the C., B. & Q. It was held that the C. & E. carded the car to suit their own convenience, and it was right that they should be required to stand between the road that did the repairs and loss.

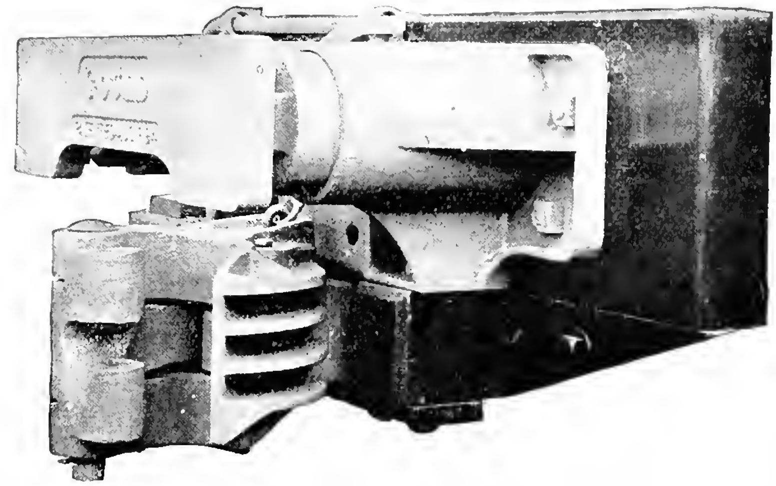
The Louisville, Evansville & St. Louis carded a car for three boards of running board gone. The Louisville & Nashville did the repairs and renewed the whole running board, charging the carding road for 90 feet of lumber. The latter objected, and the L. & N. averred that the whole running board was gone and had to be renewed. The Arbitration Committee decided that the L. & N. should have seen that no more than three boards were gone when they accepted the car. Failing in that, they were responsible for the work called for not entered upon the card. The claim was made that under Rule 8 owners of cars are responsible for defective roofs, and that consequently this covered the repairs to running boards. The Arbitration Committee did not take this view. They held that the rule did not apply to running boards alone.

A curious dispute arose between the Chicago, Burlington & Quincy and the Chicago & Erie about a broken Janney coupler knuckle on a car belonging to the former road, which had been carded by the owners for the defect named. The C., B. & Q. Janney couplers have wrought-iron knuckles, but the C. & E. repaired the coupler with a steel knuckle and charged $2.80 for the material, which is the price of a wrought-iron knuckle. The owners of the car objected to the charge, which, they said, ought to have been $1. They also mentioned that they had the right to refuse the car with a knuckle of steel, on the grounds that it was repaired with wrong material. After much correspondence the parties to the dispute decided to refer it to the Arbitration Committee, and the latter ruled that the charge should be amended to net charge for steel knuckle, less credit for scrap, which was $1.

The Gould Freight Car Buffer.

The annexed engraving shows a form of buffer recently placed on the market by the Gould Coupler Co. It requires no description. As a reason for its introduction we submit some remarks made by Mr. G. W. Rhodes, on car couplers:

"No one attempts nowadays to make a knuckle of malleable iron. Why? Because the strength is not in the metal. But, some one will say "malleable iron is quite strong enough for the drawbar." Then why propose to increase the shank from five inches to six? Surely this must be to make the bar stronger. In place of making such a radical move, and adding additional weight to an already too heavy construction, the advocate of cast steel will naturally ask, Why not use a metal for the drawbar that most malleable iron manufacturers admit is the strongest for the knuckle? We fully believe this is what we would eventually come to were it necessary to always concentrate both buffing or pulling strains on the unfortunate drawbar. But I do not believe this is the case. It is only the poorest kind of construction that makes it necessary to have the bar do both buffing and pulling. When those who are responsible for the present crude condition of things realize the great expense that it is putting upon the cars, we will have buffers for buffing work and drawbars for draft work. Buffers formerly used to be very general on the equipment of almost all the cars in the East, and drawbars weighing 100 pounds, and the lightest kind of draft rigging, were considered quite admissible. With the introduction of the M. C. B. bar, curiously enough, buffers were almost everywhere abandoned, and the narrow short horn back of the drawbar was considered a sufficient substitute. But a change is coming now, and has been gradually coming for several years. Some of the lines in the East have learned, if they did not know it before, the cost of maintaining equipment without buffers, and are again beginning to apply them. The private car owners are following suit, and, best of all, one, at any rate, of the coupler manufacturers is putting on the market spring buffers for freight cars. This latter, we believe, is a great step in the right direction. It will tend to do away with the ponderous drop test blows that have seemed almost a necessity, and will enable manufacturers to lighten rather than add to the weight of the already quite sufficiently expensive M. C. B. automatic drawbar."



"The Wheel, the Tire and the Shoe" is the name of an illustrated pamphlet recently issued by the Sargent Co., of Chicago, Ill., for the purpose of describing the action of a brake shoe which the company has put upon the market. It is of the kind which dresses the wheel tire on the part not worn by the action of the tire on the wire, and has every appearance of being highly efficient for that purpose. The shoe is of the flange kind, like the Ross shoe, and is adapted for locomotive and passenger service. Those who desire more particulars about this shoe should apply to the company for a copy of the pamphlet.

A novelty in the way of a combined door mat and feet scraper has been invented by Mr. J. M. Morton, of Cedar Rapids, Iowa, which seems to be a very desirable article to place on the platform of passenger cars. It could be placed there with little expense, and would quickly pay for itself in the saving of car carpets and seats from soiling by the constant wetting and the muddy feet of passengers.

A book of tools, machinery and supplies, published by Chas. A. Strelinger & Co., Detroit, Mich., is a highly useful publication and appears to fill a long-felt want in a masterly way. There are few articles used in the machine trade that will not be found described briefly and illustrated in this book, with particulars as to price and where it can be purchased. The book will be found very useful for reference, and we advise every one interested in the purchase of machinery or mechanical appliances to send for it. Readers of LOCOMOTIVE ENGINEERING can have it by sending ten cents to the above publishers.

Platform Gates for Coaches.

Not long ago we referred to the need of platform gates on coaches not vestibuled, citing some roads where they were in use. We are glad to note that there are other roads falling into line with this safeguard to passengers.

The Great Northern has a fine arrangement of these gates. They are made of wrought iron, light and pleasing in design, hinged at either side of car door so as to swing toward the platform hand rail, and locking in that position when the car is in motion, forming a safe and roomy passageway from car to car.

When at stations, the gates are turned to fold against end of coach, leaving the steps clear, and always on the right side for passengers to enter or leave the train.

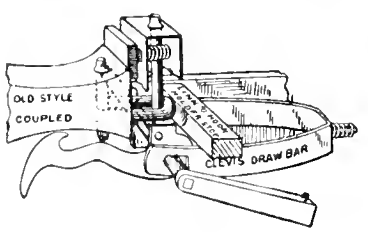
There seems to be a well-defined feeling —and the sentiment is growing—that platforms ought to go. Why not, then, make them as safe as possible while they are here, by reducing the chances for a passenger to fall from them or get off on the wrong side, to be picked up by a passing train?

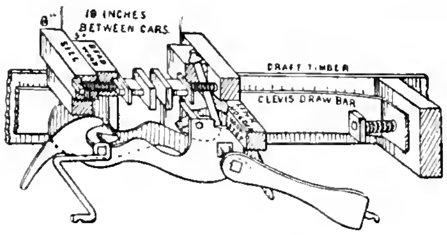
Buffet Car.

The Minneapolis & Sault Ste. Marie is about to go into the buffet car enterprise, to fill a want over there that exists on some other roads as well.

When a train is timed to leave a terminal at an hour which necessitates a long haul for the diner, the idea is a good one on comparatively short runs.

One case is recalled where, on a branch line in the West, the baggage end of a combination car was transformed quickly into a neat buffet car, by introducing a small steel range, a couple of tables and a sideboard. The menu consisted of coffee, good bread and butter, cold meats, etc., just the provender that satisfies a grub-yearning soul and the purse without the wealth of a Golconda. These cars were a good thing—satisfied the patrons and paid the company. If the "Soo" don't find the investment a good one, it will be because the people don't know a good thing.





Heath's Automatic Gravity Car Coupler.

We have received from the proprietor of this coupler, whose address is Covington, Ind., an illustrated circular which makes claim that this coupler fulfills all thirty-five requirements of railroads, or forfeits $100. We don't know what the thirty-five requirements are and we leave it to our readers, who may be able to work it out with the illustrations as a key to the problem. The proprietor of the coupler seems to be a person of economical habits, for on the back of the one-cent stamped envelope containing the circular he writes: "Get and mail to me bids on within coupler. He pay you 10 per cent. of what I get if I sell to one of them." As we have too much to do without going into the business of selling car couplers, we pass this magnificent offer along to our ambitious readers.

Oh! For Good Brakes!

In the course of a paper read by Mr. W. W. Snow before the New England Railroad Club, giving particulars of travels in Norway, he related the following striking incident:

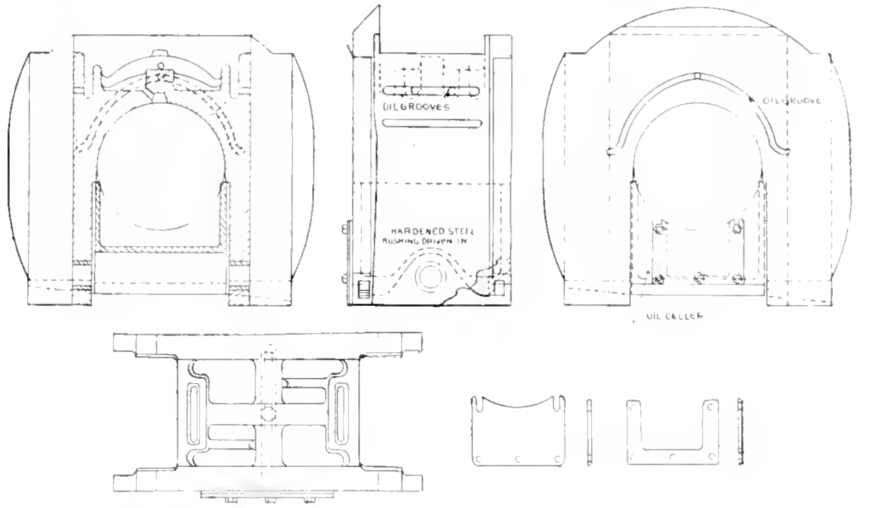
"It was a bright and beautiful Sunday morning when our party left Egge with fourteen carrioles to cross the mountain to Utviken. The writer of this article, having the smallest pony and being the heaviest individual in the party, and in the lead, started to go down the mountain. The first descent being very steep, the pony could not hold the carriole, and the driver, a small boy of ten years old, was of but little service in assisting the pony to hold back, and there being no Ross-Meehan brake shoes on the car, we went sliding down the mountain with the carriole, boy, passenger and pony locomotive with all his four drivers blocked. As there was a precipice about a thousand feet high on one side, the writer looked carefully on the other side for some automatic switch stand; but as there was none in sight, he decided to put his trust in Providence until the breeching should break. However, as all things come to him who waits, the ride was finished and without serious accident."

An Improved Driving Box.

Our engraving shows the details of construction of the solid bronze driving box used on the latest class "P" express engines on the P. R.R.

Particular attention has been paid to insure oiling in the proper places, as can be seen by a glance at the engraving.

The oil pocket on top of the box feeds directly into the crown cavity on top of the axle. There are two little pockets on



top that feed directly on to the wedge and shoe, and in the center rib of the crown there is a boss raised above the oil level, as shown in the left-hand cut; this feeds directly to the curved oil grooves on the face of the box next the wheel hub, as shown in the right-hand cut.

The main oil cavity is not drained to oil wedges and shoes; the oil used for this purpose can go to no other place, and the places that need oil are sure to get it.

The boxes have provision for carrying the underhung springs, and the cellar is of light construction, easily removed and having an adjustable plate on the end to keep up to axle when box wears at crown, and to allow repacking without taking out.

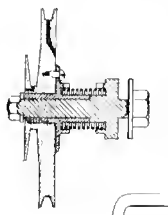
An improved form of storm and spark proof door has been invented and patented by Mr. P. T. Mooney, master car builder of the Texas Central R. R., at Walnut Springs, Texas. Texas railroads have a great deal of cotton and other inflammable freight to transport, and an efficient spark-tight door is of the utmost importance. This necessity has guided Mr. Mooney in working out the details of his invention, with the result that he has produced a door which seems to be among the best ever put upon the market.

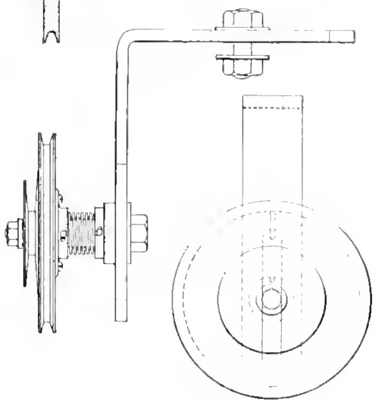
A suit for damages has been brought by J. W. Lishman against the St. Louis Southwestern Railway of Texas, because the latter company failed to have lavatory conveniences on the car where the complainant was a passenger. He claims to have suffered great inconvenience, annoyance and humiliation from this want of accommodation.

A Simple Reducing Motion.

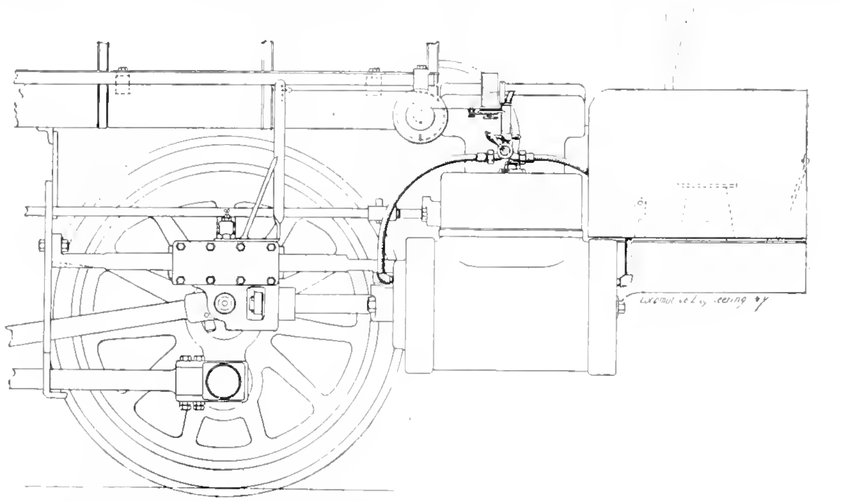
The reducing motion shown herewith is one used by M. H. J. Travis, chief draughtsman of the Manhattan Elevated road, in this city.

The wheel is made of wood, as shown in the details, no trouble being had with its "throwing" or tending to revolve farther than the cord pulls it.





Of course, the elevated engines do not run at excessive speeds, and there is less danger of distortion from this cause than there would be on a flyer.



A Simple Form of Reducing Motion.

Electrically Operated Shop Tools.

In the last two issues of Locomotive Engineering mention was made of the application of electrical power direct to the machine tools in the shops of the Baldwin Locomotive Works.

A concern in Dayton, O. (the Shawhan Electrical Mfg. Co.), have recently achieved a notable success in a complete electrical power plant for the King Powder Co., of Cincinnati, the electricity being generated by several immense turbine water wheels which are directly connected to the generators. The saving by the combined use of water and electric power is surprising. One item alone is three carloads of coal each day and the trouble and expense of handling it. The main circuit covers 1½ miles or more.

This same company is at work on plans for equipping the extensive car works of Barney Smith & Co. with electrical power, and is willing, in this instance, to guarantee a saving of 50 per cent. over the old method.

Many large railroad shops are, or might be, located where electrical power could be generated and transmitted for use direct to any machine, at even a greater saving than 50 per cent.

Where steam power and belts are used the expense of power is about the same, whether the shops are running light or heavy; but with electrical power, even when generated by steam, like the new plant of Fraser & Chalmers, in Chicago, there is little useless work done when individual machines are not at work.

Small Thanks for Favors.

There are certain classes who use railways for freight transportation that would keep yelling against the exactions of railroads if they got their goods hauled for nothing. There are numerous industries that have been developed by the cheap rates given by railroads, yet those who ought to be most thankful, return for the favors the blackest ingratitude. The latest example of disgusting thanklessness is that of the fruit growers of California, who, in convention assembled, passed resolutions blaming the railroads for not providing all the facilities desired.

These same fruit growers have been petted and spoiled by the extraordinary favors granted them by railroads. They pay smaller rates than any other perishable article. Fast lines of freight have been established for their benefit, the trains are frequently run at express train speed, and everything possible is done to get the fruit promptly to market. The New York *Commercial Advertiser*, commenting on this subject, says:

"The average charge for hauling all freights in the United States by railway in 1893 was 89 cents per ton per 100 miles. This rate includes coal, coke, iron ore, limestone, pig iron, steel rails, lumber, building stone, bricks, etc., etc., etc., which are hauled upon platform cars and do not require any attention and are not perishable. The average charge for all railway freights in Great Britain in 1893 was $2.80 per ton per 100 miles. In France, where the Government operates many of the railways, the cost is $2.20 per ton. In Germany $1.68 per ton is exacted. In Australia, a colony of England, where the railways were built by the State and are operated by it, as we stated in a previous issue, the charge for hauling butter from the interior to tide water for export is $10 per ton per 100 miles.

"To haul a car from the fruit orchards of California, Oregon or Washington, 3,500 miles to New York, costs $300 for ten tons of fruit. At the English rate it would be $980; the French rate, $770; the German rate, $588, and at the Australian rate, $3,500 per carload.

"The managers of our transcontinental lines appreciate the fact that green fruit cannot be sold in this market in competition with Eastern fruit and pay a high rate of freight per ton per mile, and therefore to develop the industry they have given the fruit growers of the Pacific coast a rate which is below cost. The fruit growers have less reason to complain of railways than any other agriculturists or fruit culturists in the world.

"Our transcontinental railways have made it possible to grow fruit and have it sent 3,500 miles over the Rocky Mountains to the cities upon the Atlantic coast and sell it in prime condition at a good profit to the intelligent, conscientious and careful fruit culturist."

One of the latest and most ambitious patents taken out in connection with the locomotive, is one which proposes to surround the engine with nozzles so that the machine will look like the quills of a porcupine. The object of these nozzles is to blow out boiling water and steam when any train robber attempts to board the locomotive without the consent of the men in charge. It is a great scheme, but we fear it is not destined to greatly obstruct the popular business of train robbing, as the ruffians who follow this line of industry would not hesitate to open a switch and ditch a train if they thought that the locomotive was protected against their intrusion.

The Philip Carey Asbestos Co., which make roofs for cars and buildings, had their works burned out in Cincinnati lately, and they have arranged to build an extensive plant at Lockland, O., a short distance from Cincinnati.

The Columbian Metallic Packing Co. have moved their offices to the Betz Building, Philadelphia. They report business to be improving.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(1) C. B. A., Columbus, O., writes:

What metals expand and contract most under changes of temperature? *A.*—Zinc expands and contracts most, then lead, silver, tin, brass and copper, respectively.

(2) R. A. M., New York City, writes:

Do you think it is likely that the elevated railroads in this city will ever be operated by electricity? *A.*—We do not wear the robe of a prophet, but it looks as if the railroads named would some day be operated by electricity.

(3) C. P., Duluth, Minn., asks:

Which is the best material for boilers, iron or steel, the price not being of much consequence? *A.*—Steel, by all means; but steel that conforms to Master Mechanics' Association or American Boiler Manufacturers' specifications.

(4) J. N., Cohoes, N. Y., asks:

How are the adjustments made that the lead of a locomotive with link motion increases as the lever is drawn towards the center, while in a marine engine the lead decreases? *A.*—If the eccentric rods are crossed the lead decreases as the link is drawn towards the center.

(5) E. C. Smith, Cainesville, Mo., writes:

I saw an engine the other day that would take a light train and make time when she was hooked on the center. I think that she should not do that, as the valve would not have enough travel. The engine crew say it is O. K., and I say no. What do you say? *A.*—There are many locomotives that will do this.

(6) W. M., Albany, N. Y., says:

1. With what success have experiments been made in burning oil as fuel in locomotives? *A.*—With entire success. There are hundreds of locomotives in Russia that use no other fuel than oil. 2. What are the principal obstacles to be overcome to make oil-burning a success? *A.*—To obtain oil cheaper than coal or wood.

(7) C. A. C., Cedar Rapids, Ia., writes:

In reading an engineering publication I have found the expression "angle of repose" used several times, and I am at a loss to understand its meaning. Will you explain it? *A.*—If you take a brick and lay it upon an inclined plane, and it does not move, it is said to be within the angle of repose. When the inclined plane is so steep that an article with a plane face will not remain on it, its inclination is said to be outside the angle of repose.

(8) A. S. M., Clinton, Ia., writes:

1. Have copper fireboxes and brass tubes ever been used in this country? *A.*—Yes. 2. If they have been used, why were they abandoned? *A.*—Because iron was found to be more economical. 3. Is the superior conductivity of copper and brass not likely to make that material for heating surface more economical in the end, even if the first cost may be a little greater? *A.*—Only very careful tests could demonstrate that. We doubt if the practical difference is material.

(9) T. H. G., Elmira, N. Y., writes:

1. What is the proper size of steam and exhaust ports and bridges of an engine with cylinder $2\frac{1}{8}$x3-inch stroke? *A.*—About $1\frac{1}{2}$-inch long, steam ports $\frac{5}{16}$-inch, exhaust port $\frac{5}{8}$-inch. Bridges should be about the same thickness as the metal of the cylinder. 2. How much power will this engine develop while running 300 revolutions per minute with 100 pounds steam pressure? *A.*—About $\frac{3}{4}$ of a horse-power, taking 50 pounds as M. E. P.

(10) F. C. M., Salem, N. Y., writes:

I want to know what difference it will make in the travel of the valve if the hanger stud be placed in the middle of the link or towards the front instead of behind the center? *A.*—The angularity of the connecting rod tends to delay the cut-off during the backward stroke and to accelerate it during the forward stroke. Placing the hanger stud behind the center corrects this irregularity of cut-off. If the stud was moved ahead the engine would not cut off evenly.

(11) H. W. K., De Soto, Mo., writes:

Seeing that a great many of your subscribers ask your opinion or decision on mechanical points, I would like to ask you your opinion on fitting a taper key in a shaft. Which key would give the best results, one with the bearing on the sides, or one with the bearing on top and bottom, and how is the proper way to fit a key to get the best results? *A.*—All keys ought to be fitted to have good side bearings. There really ought to be no top bearing. If fitted with a tight bearing top and bottom, the key becomes a wedge which tends to force the eccentric out of round.

(12) S. A. M., Fargo, N. D., writes:

1. What is the difference between steam and compressed air of, say, 140 pounds, as regards expansion and elasticity? *A.*—They are practically the same. 2. Would passing air through a reservoir of hot water affect it any, and, if so, to what extent? *A.*—The pressure of the air would be increased or the volume increased in proportion to the amount of heat imparted to the air. If the volume is kept unchanged, the temperature will rise 1 deg. Fah. per pound of air for each .169 of a heat unit imparted. 3. Is there any lathe or other practical tool for turning the tires of locomotives without removing them from under the engine? *A.*—We never heard of a successful one.

(13) J. N. R., Vicksburg, Miss., writes:

1. Which will produce the best results in a locomotive boiler, a large number of small tubes or a reduced number of larger ones? *A.*—A greater area of heating surface can be obtained by the use of small tubes, but small tubes are very liable to get choked up. For locomotives, tubes of about 2 inches diameter are found to be most serviceable. 2. Which is the best and safest boiler, the straight or the wagon-top? *A.*—Both have their good points and both are equally safe if properly made. 3. Is there any advantage in using copper instead of iron flues? *A.*—No; quite the reverse. 4. Which is the best form of smokestack, the perfectly straight or the tapered? *A.*—The best in this case is a matter of taste. 5. What is the safest way to fasten tubes? *A.*—By rolling.

(14) E. R. S., Angus, Minn., writes:

1. Is there any irregularity introduced on the valve cut-off by the engine moving up and down on the springs when running? *A.*—Yes; but it is very trifling. 2. Which wheels do the most effective work in going round a curve? *A.*—If you mean most effective carrying work, it is the wheels inside the curve; if it is the most effective guiding work, it is those on the outside. Both depend to some extent upon the speed and the elevation of the outer rail. At high speeds the centrifugal force will throw more weight on the outside than on the inside rail. 3. How much more lap does a valve need on the rear than on the forward end to make up for the irregular action due to the angularity of the connecting rod? *A.*—None. This irregularity is compensated for in the method of hanging the link.

Piston Rod Fastenings.

Scarcely a road in the country but is having more or less trouble with broken piston rods, especially where Laird or other forms of overhanging guides are in use. The Schenectady Locomotive Works state that they scarcely ever hear of a broken piston rod on their engines where their own form of crosshead fastening is used. They make a fit to a shoulder on the end of the rod and *back of the keyway*. This puts the strain of the driven key on a part of the rod not subject to such severe strain as that from the keyway toward piston. Then they let the taper run out without a shoulder or rod, and turn a place outside of the crosshead fit altogether that is smaller than any other part of the rod. This allows the rod to spring. This form of fastening they first used in 1887 on engines specified by Mr. Wm. Fuller for the Colorado Midland.

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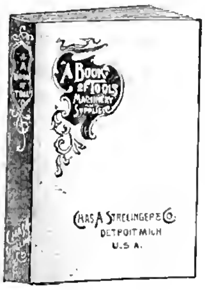

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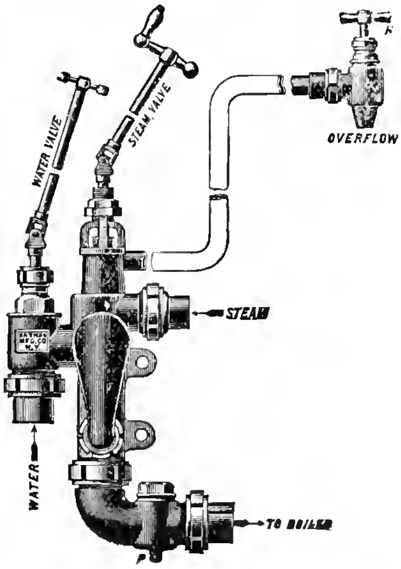
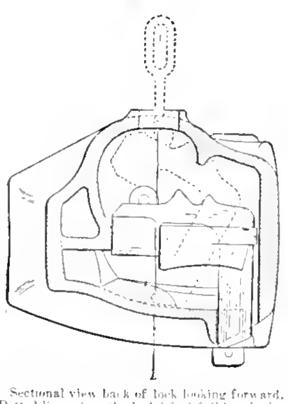


THE TOWER COUPLER.



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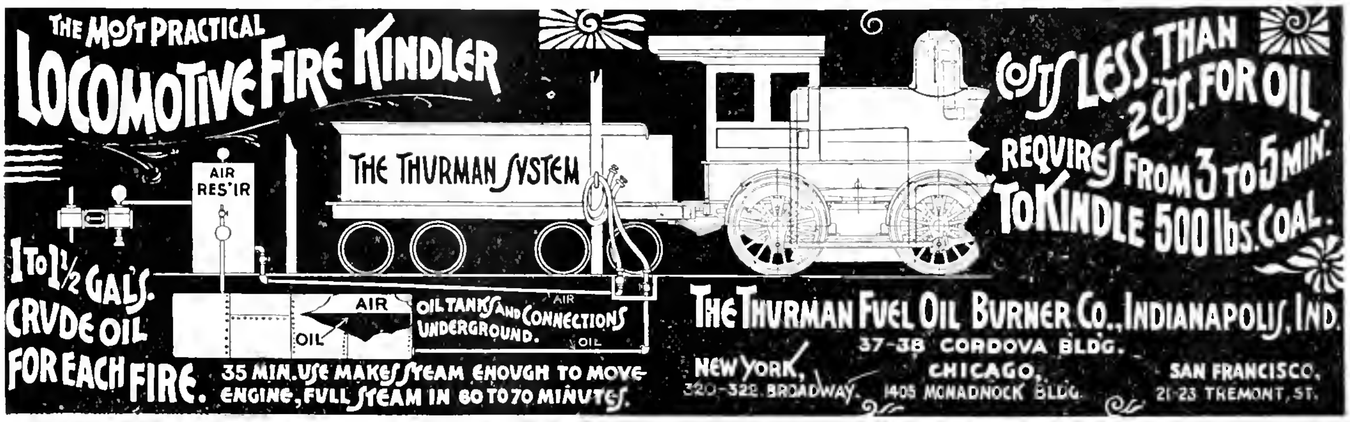

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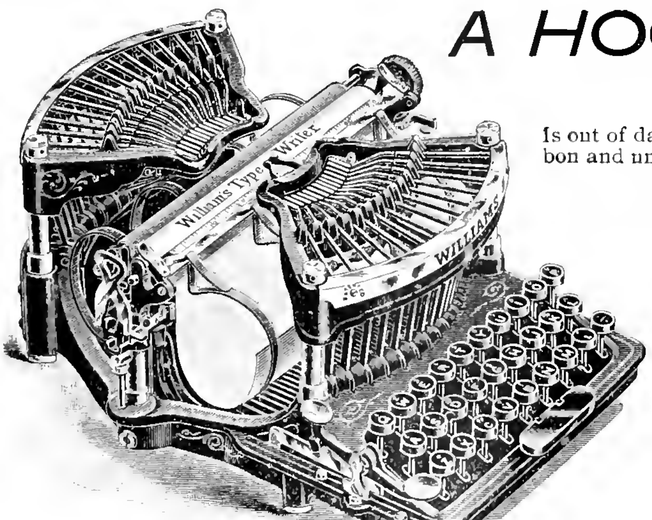

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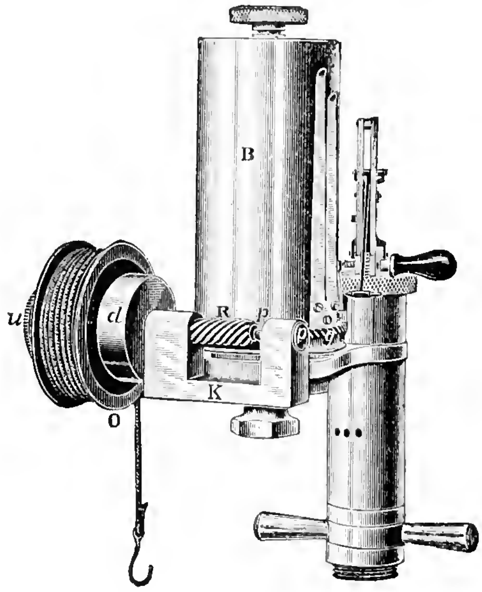

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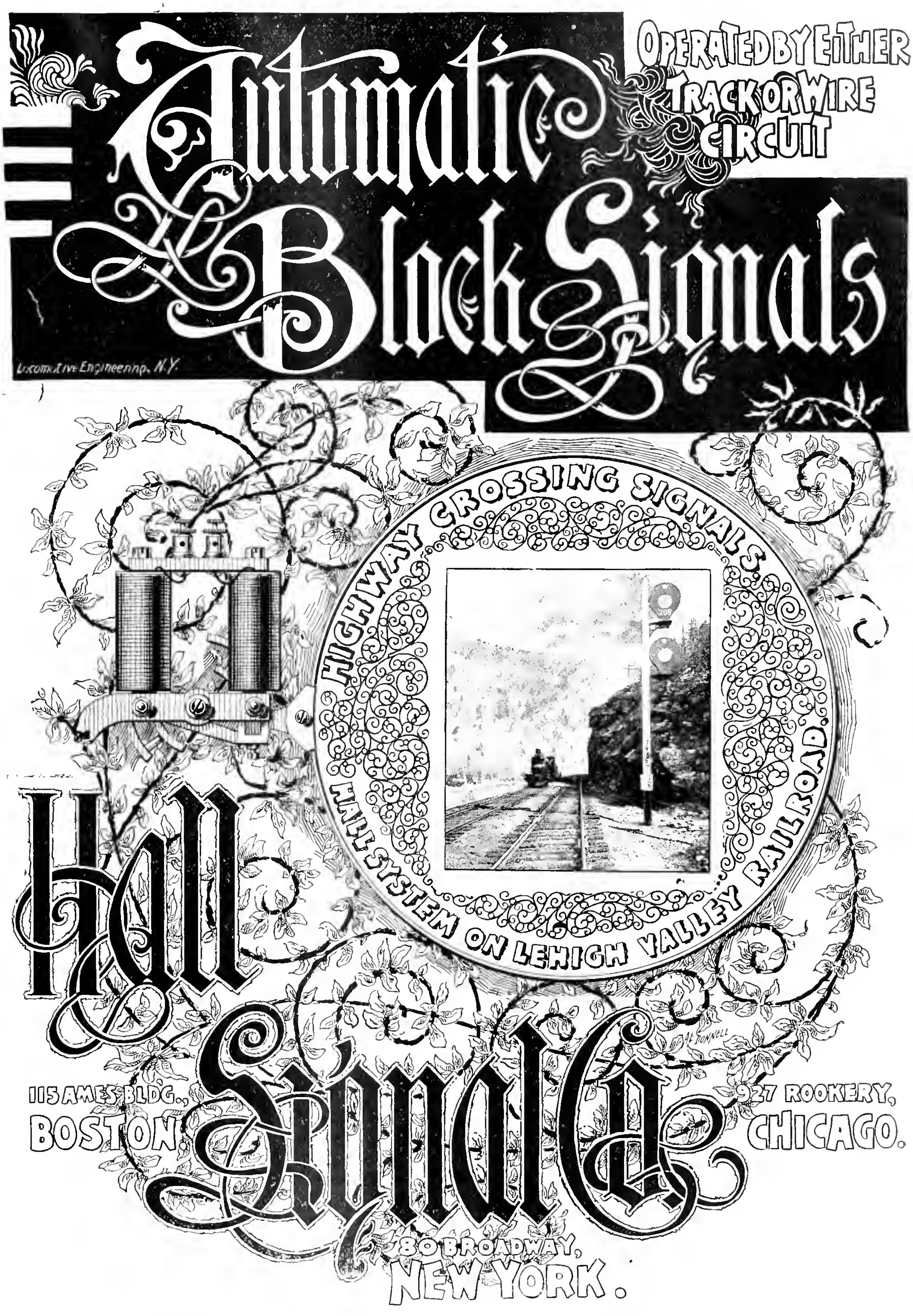
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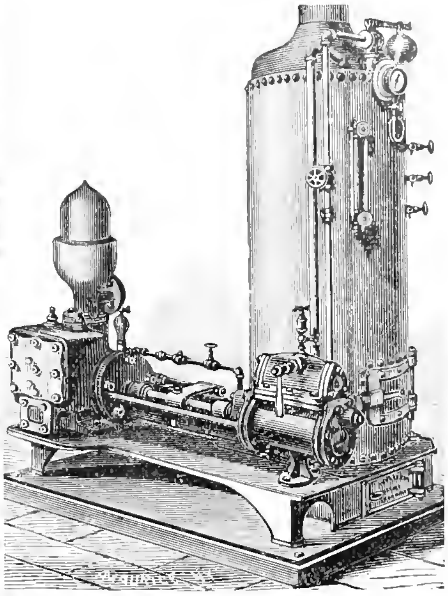

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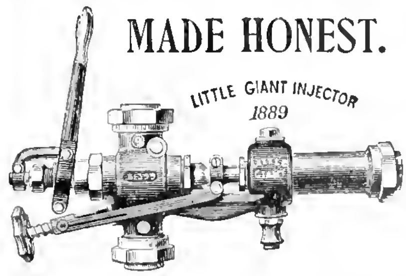

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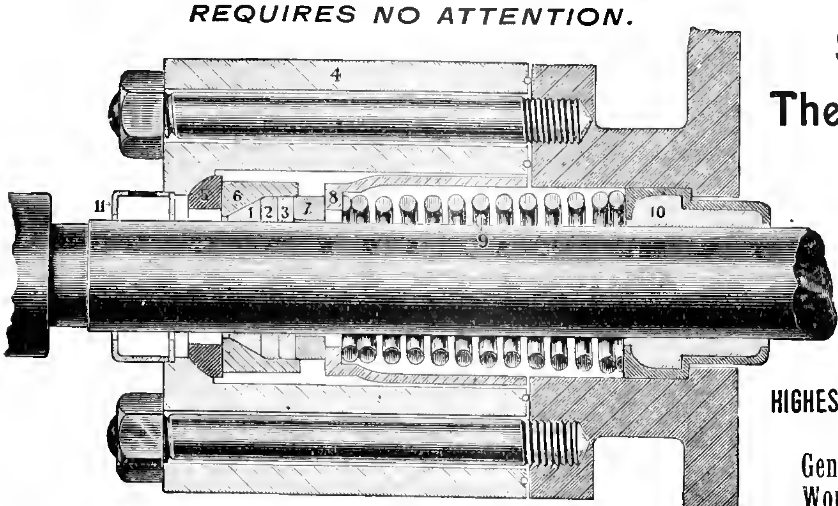

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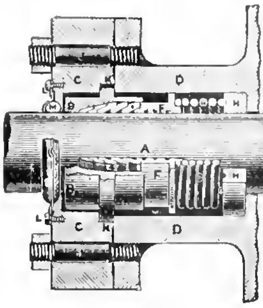

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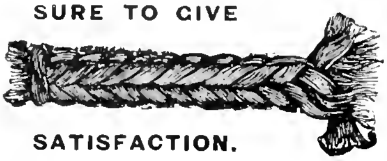

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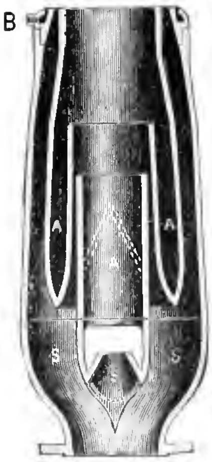
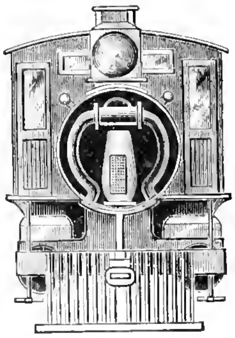
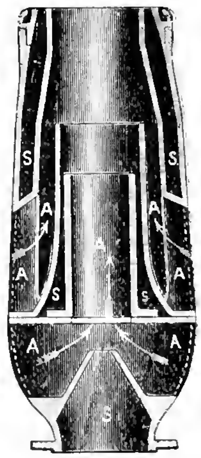


FRONT VIEW.

THIS DEVICE is the invention of JOHN Y. SMITH, the originator of the Smith Vacuum Brake. In the cuts of the Front and Side Views shown herewith, "AA" represent Air Passages; "SS" Exhaust Steam Passages, and "B" an Annular Blower forming part of the Nozzle.



It is an entirely new departure in the construction of Exhaust Pipes for Locomotives. Its distinguishing features are that the exhaust steam is not restricted after it leaves the cylinders, and the gases and heated air in the smoke arch are mingled with the exhaust steam in the exhaust pipe. The exhaust steam is thus superheated and expanded and a powerful, prolonged, pulsating blast is created, which keeps the fuel in a constant state of agitation, and produces more perfect combustion. Some of the beneficial results obtained are: *Reduction of Back Pressure to a minimum (area of nozzle opening as large as the exhaust port); prevention of ejection of sparks from smoke stack; almost complete absence of noise from exhaust; prevention of formation of clinkers in firebox; large saving of fuel.*



SIDE VIEW.

By the elimination of Back Pressure we have demonstrated the fact that the power of engines has been increased to be able to pull from thirty to sixty tons more than with any other form of exhaust pipe.

The pipe can be used with either straight or diamond stacks, in long or short front ends, and on locomotives burning hard or soft coal, wood or coke.

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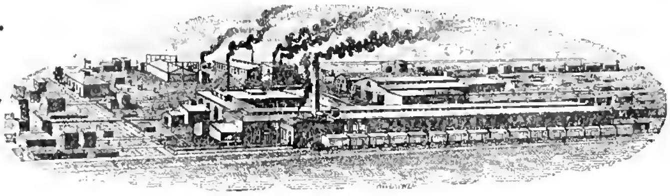

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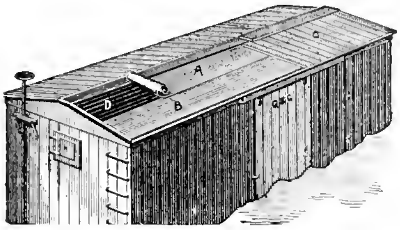

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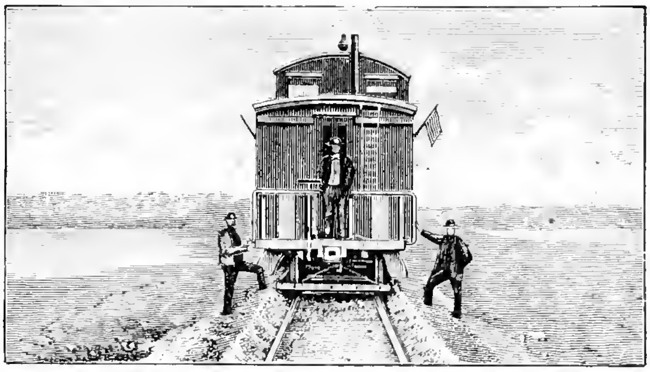

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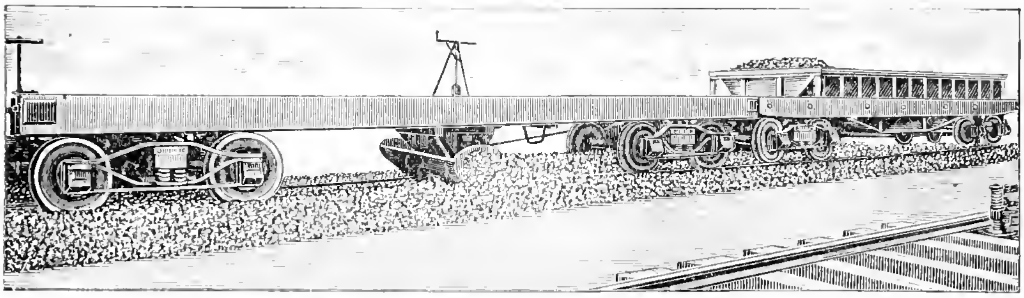

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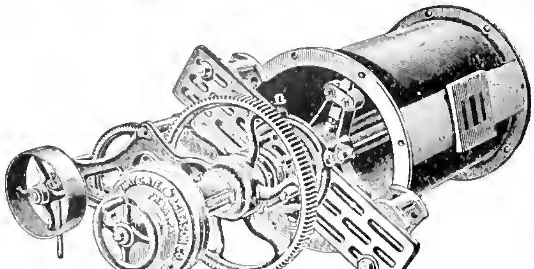

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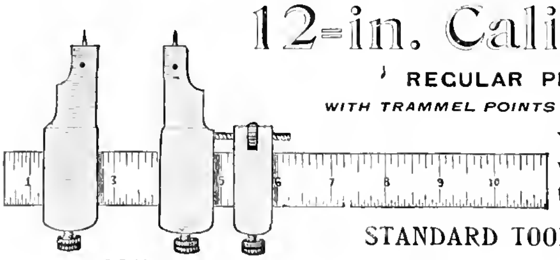

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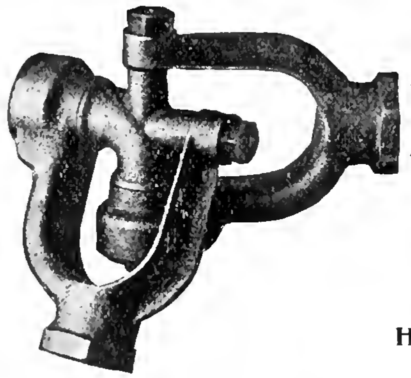

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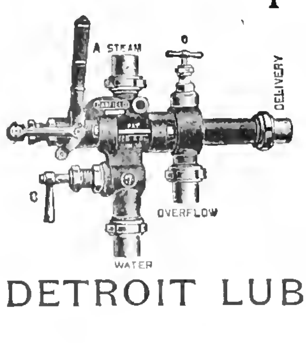

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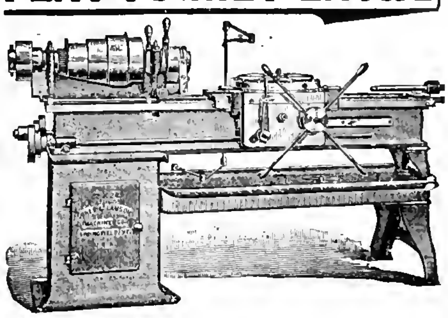

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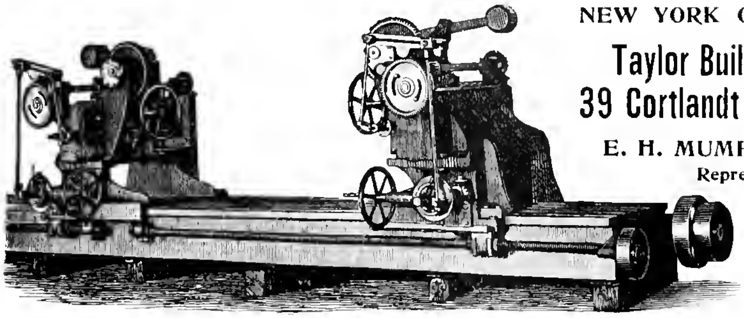

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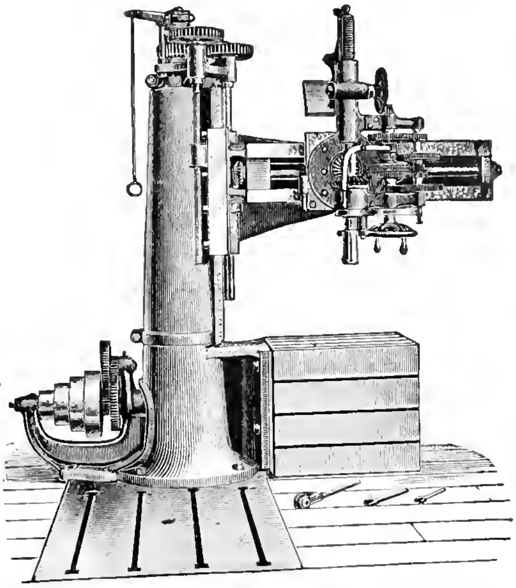

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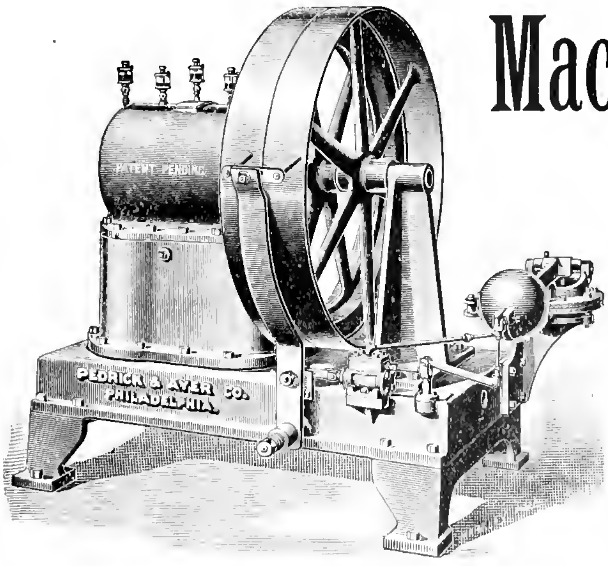

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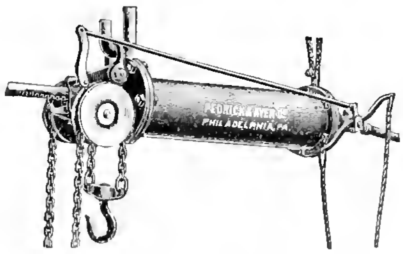

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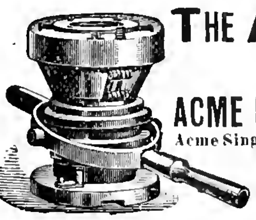

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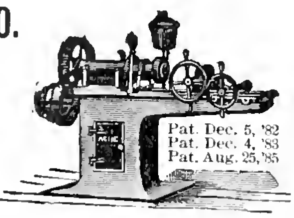

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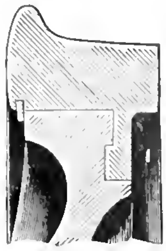

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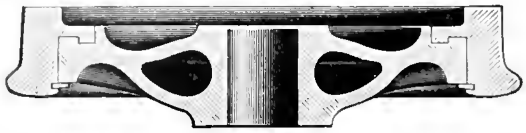

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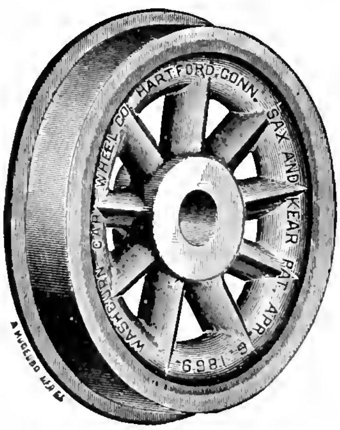

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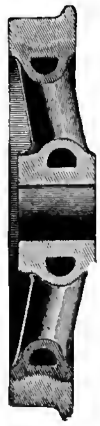

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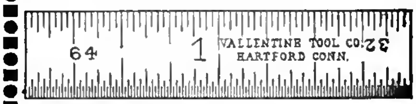

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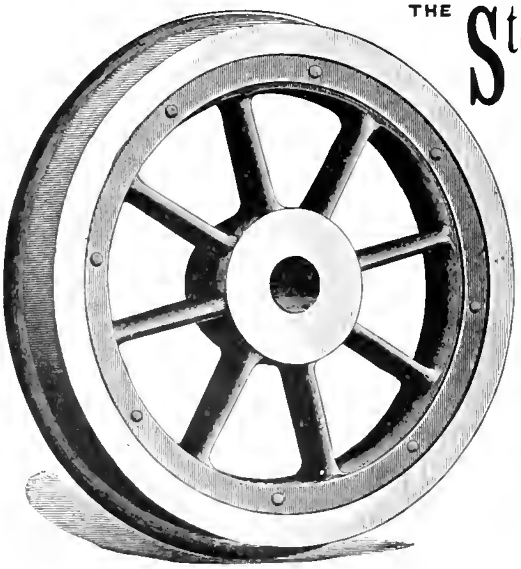

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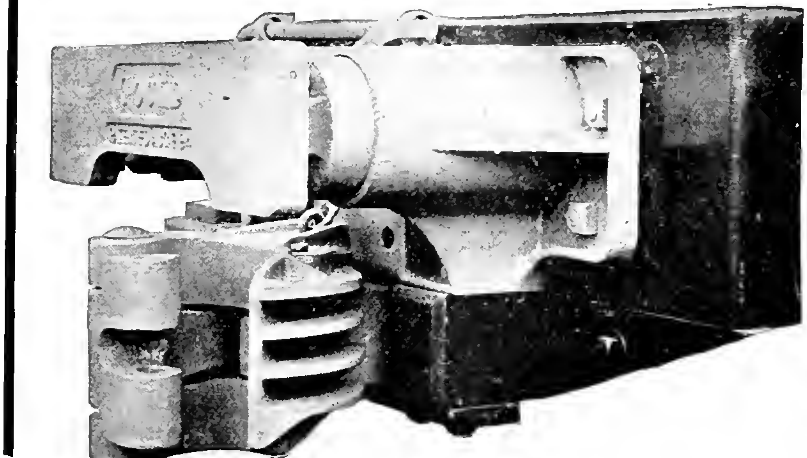

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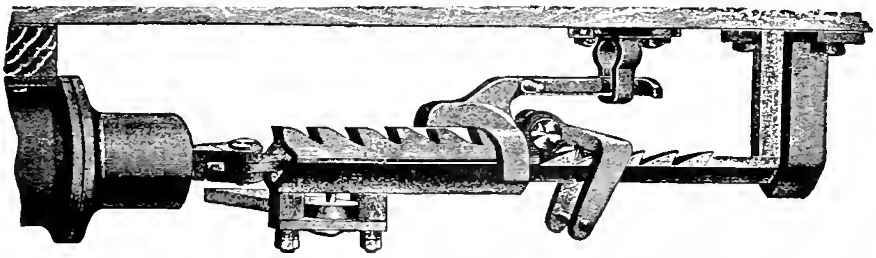

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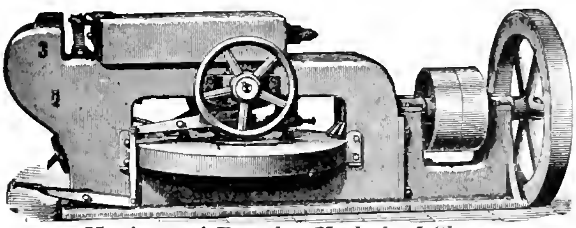

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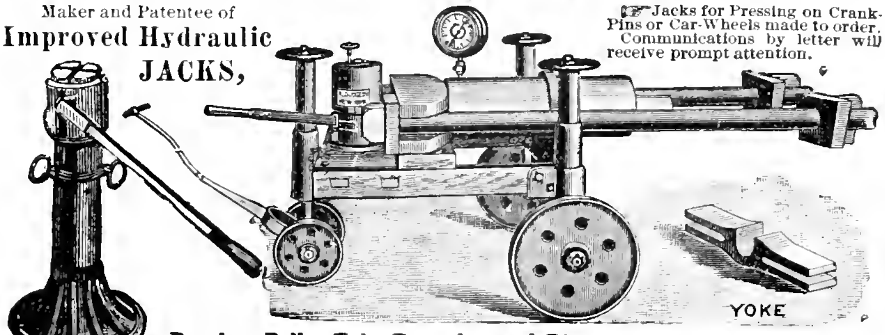

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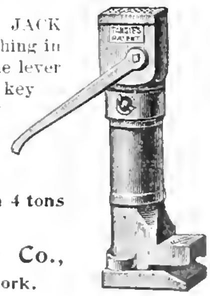

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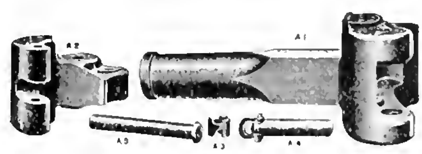

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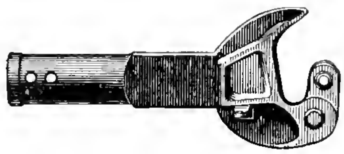

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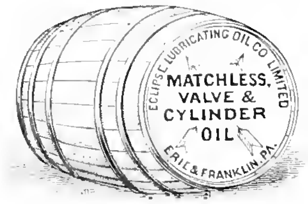

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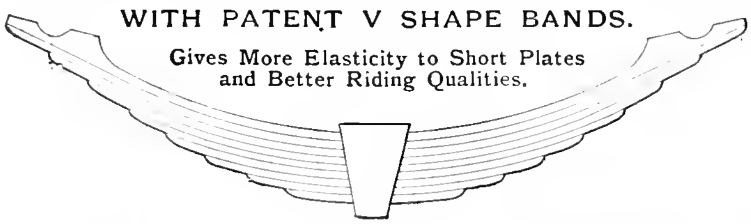

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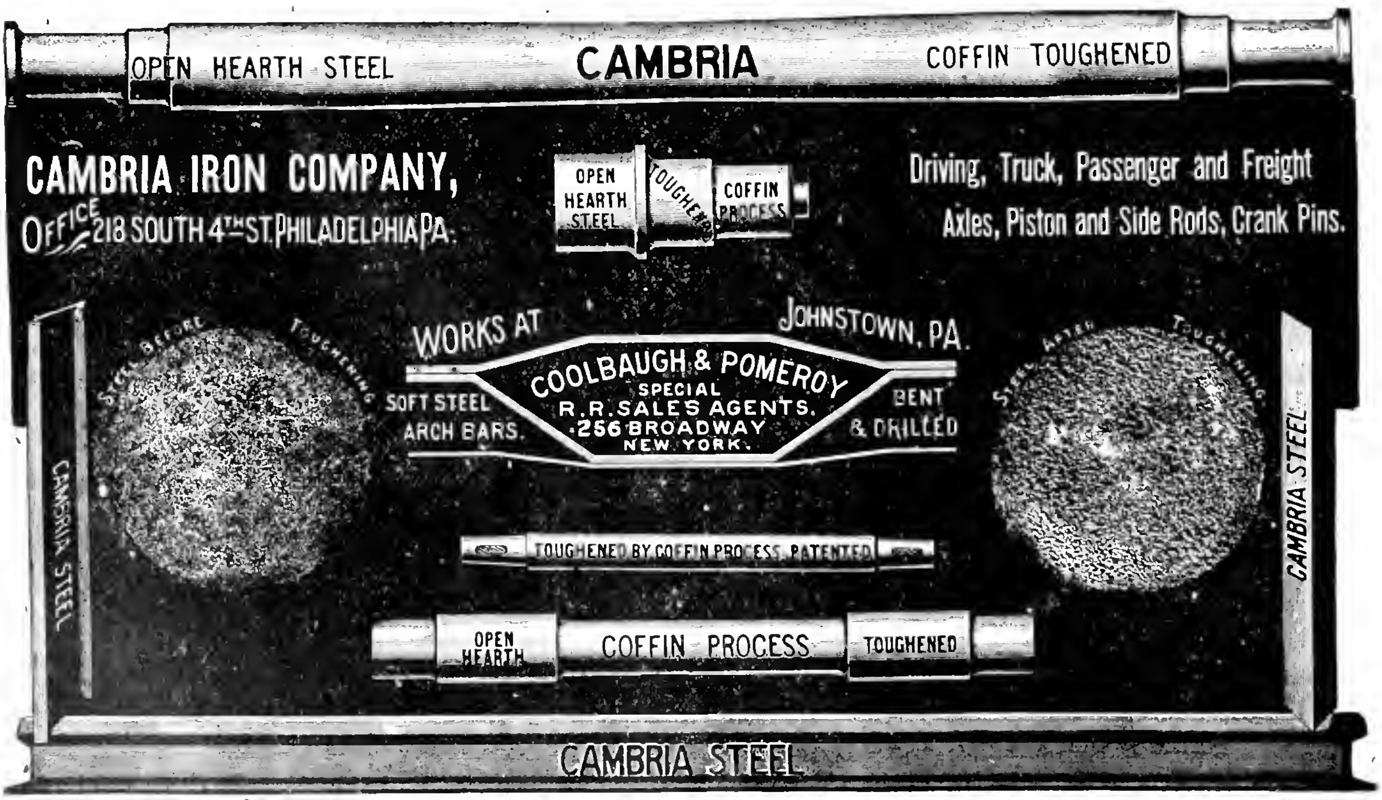

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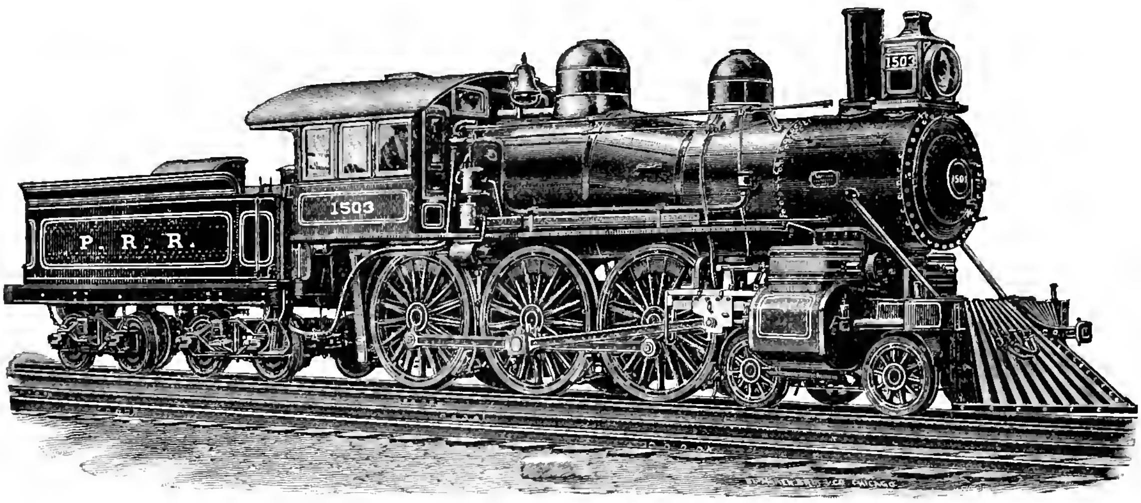

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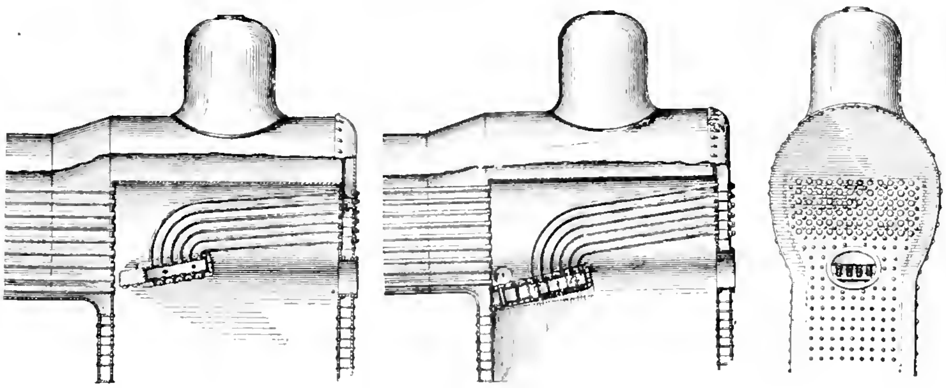

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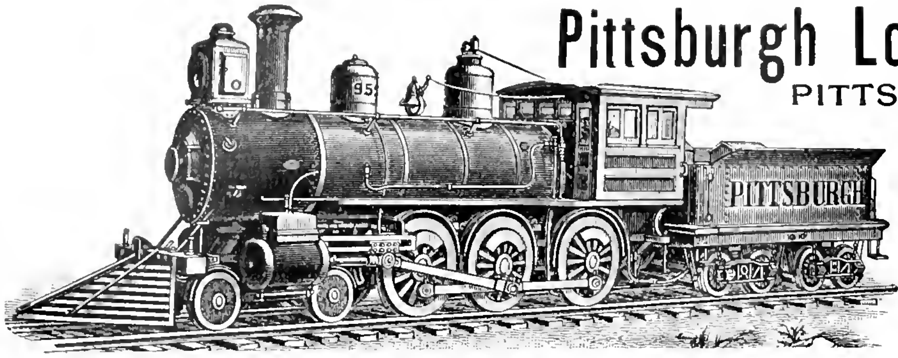

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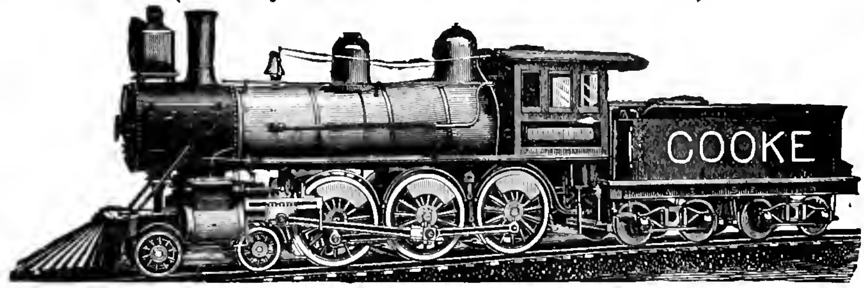

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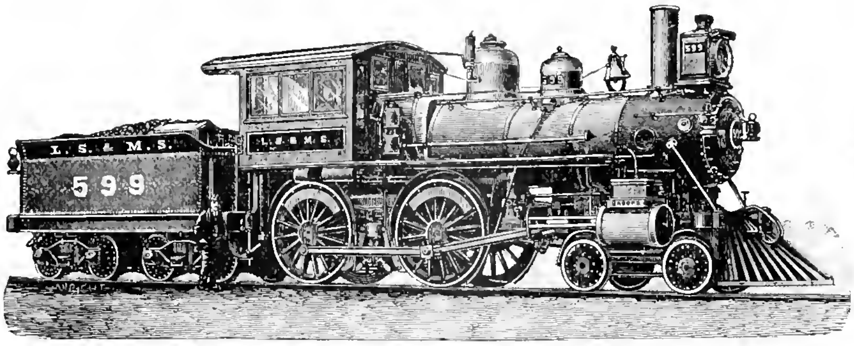

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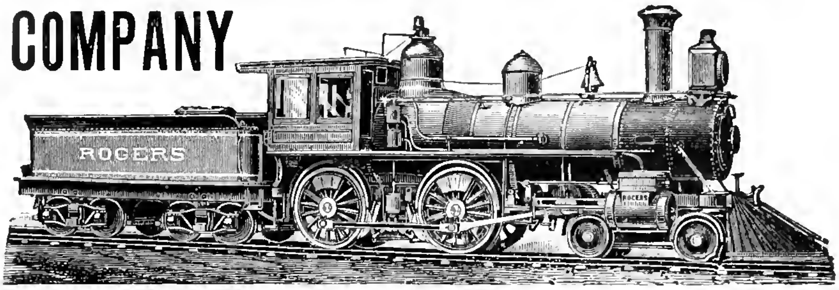

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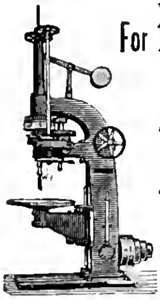

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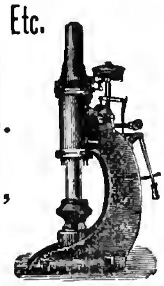

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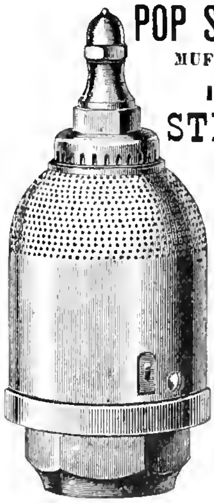

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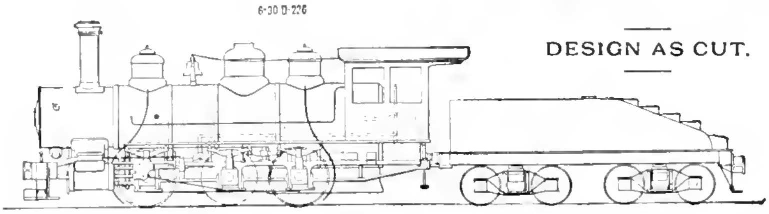

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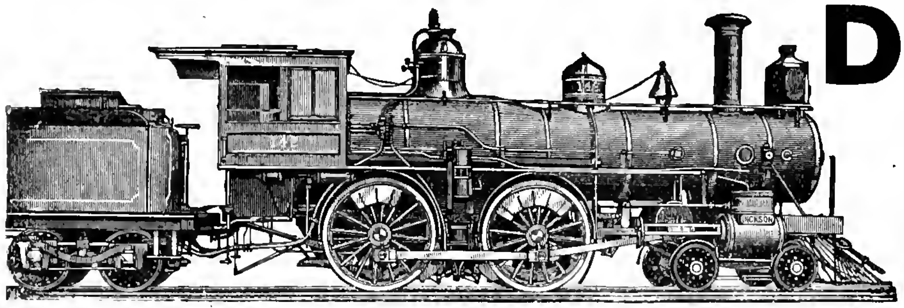

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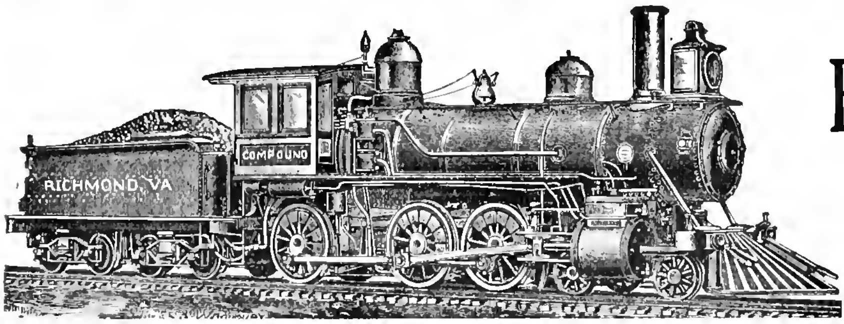

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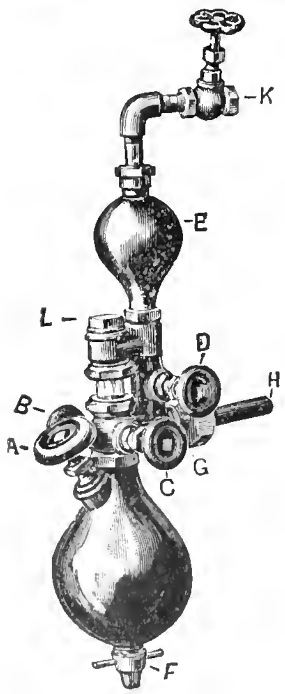

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Classified Index of Our Advertisers.

Continued on page 80.

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Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.

Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N. Y.

Rubber.
Peerless Rubber Mfg. Co., New York.

Rubber Matting.
Peerless Rubber Mfg. Co., New York.

Safety Valves
Ashton Valve Co., Boston, Mass.
Consolidated Valve Co., New York.
Crosby Steam Gage & Valve Co., Boston, Mass.

Sanding Apparatus
Henry L. Leach, Boston, Mass.

Screw Jacks
Chapman Jack Co., Cleveland, O.

Shafting
William Sellers & Co., Philadelphia, Pa.

Snow Plows
Leslie Bros. Mfg. Co., Paterson, N. J.

Springs
A. French Spring Co., Pittsburg, Pa.

Spring Steel.
Thomas Prosser & Son, New York.

Stay Bolts
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay Bolt Co., Cuyahoga Falls, O.
B. M. Jones & Co., Boston, Mass.

Steam Gauges
Ashcroft Mfg. Co., New York.
Crosby Steam Gage & Valve Co., Boston, Mass.

Steam Hammers
Bement, Miles & Co., Philadelphia, Pa.

Steam Hose
Peerless Rubber Mfg. Co., New York.

Steam Pumps
A. S. Cameron Steam Pump Works, New York.

Steel
Cambria Iron Co., Philadelphia, Pa.
Carbon Steel Co., Pittsburg, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Latrobe Steel Co., Latrobe, Pa.
Lukens Iron & Steel Co., Coatesville, Pa.

Steel *Continued.*
Schoen Mfg. Co., Pittsburg, Pa.
Shoenberger & Co., Pittsburg, Pa.

Steel Tired Wheels.
Thomas Prosser & Son, New York.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Thomas Prosser & Son, New York.
Standard Steel Works, Philadelphia, Pa.

Stone Crushers
Gates Iron Works, Chicago, Ill.

Switches.
Ramapo Iron Works, Hillburn, N. Y.

Tanks.
Pittsburg Locomotive Works, Pittsburg, Pa.

Tool Steel
B. M. Jones & Co., Boston, Mass.

Track Equipment.
Ramapo Iron Works, Hillburn, N. Y.

Tube Expanders.
Henry C. Ayer & Gleason Co., Philadelphia, Pa.
Richard Dudgeon, New York.

Turnbuckles
Cleveland City Forge & Iron Co., Cleveland, O.

Turntables.
William Sellers & Co., Philadelphia, Pa.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.

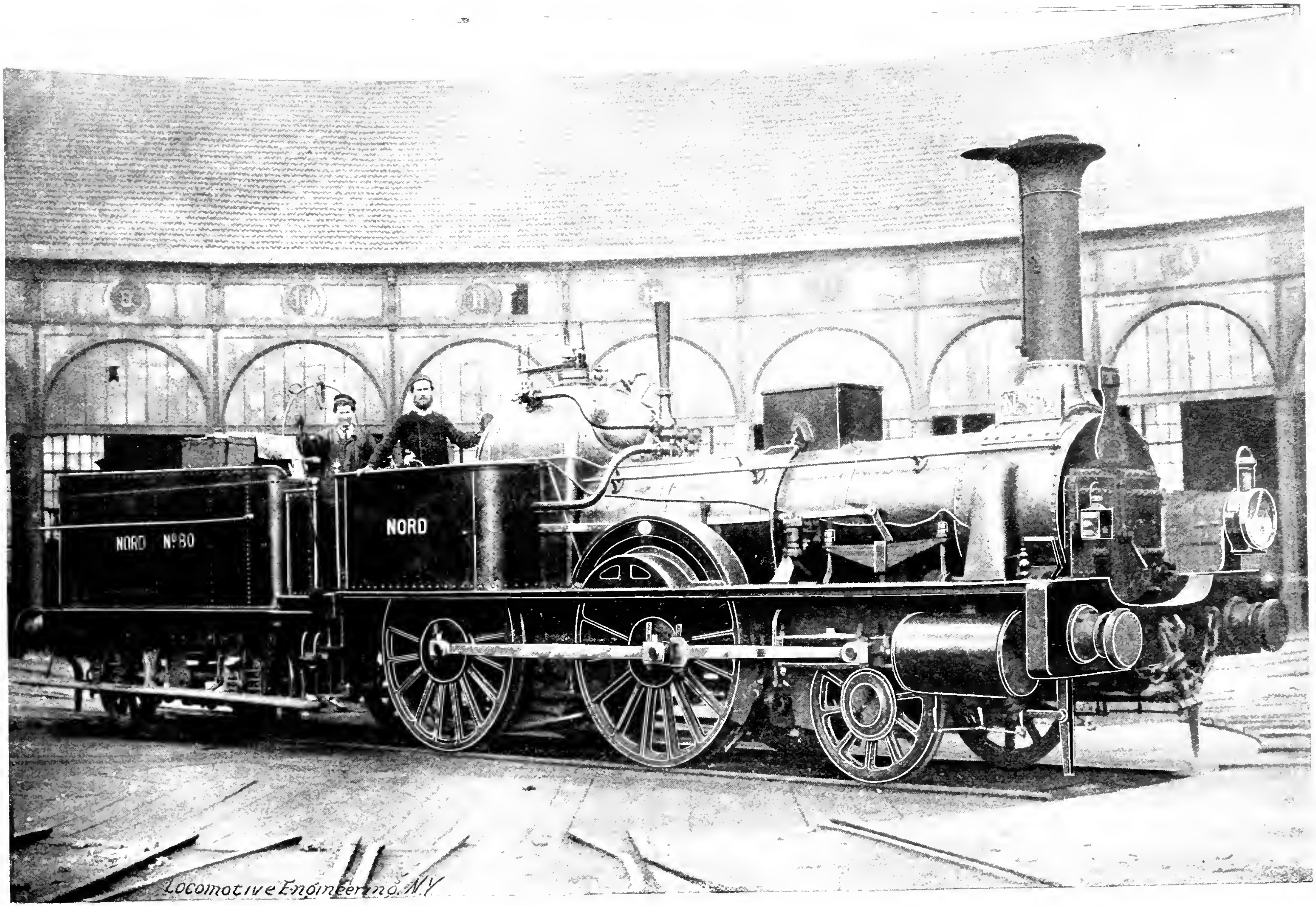
Typewriters.
Williams Typewriter Co., New York.

Valves.
Jenkins Bros., New York.
Ross Valve Co., Troy, N. Y.

Vestibules
Gould Coupler Co., Buffalo, N. Y.

Watches.
John J. McGrane, New York.

Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia, Pa.



A GENTLEMAN OF FRANCE

New York, Feb. 1895
Locomotive Engineering
Volume VIII. A Practical Journal Number Two.
of Railway Motive Power and Rolling Stock.

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A Gentleman of France.

How would some of our boys in the northern part of the country like to buck snow with the locomotive shown in the full-page print on the opposite page?

This class of engine is old and out of date, having first appeared late in the 60's, but there is many a one of them prowling around Europe with that kind of a cab on.

There is little protection from the weather, but there is an awful saving of spit and elbow grease, used up on our style, in keeping the windows clean.

A Liberal Kind of Train Order.

Mr. J. N. Galbraith, superintendent of the Northern and Texas division of the Mexican National road, has in his possession the original order issued by the transportation department when the El Salto branch of the road was opened; the copy below will show how easy the chief was as to leaving time. If men would always heed the closing remarks of the order—referring to "objections or obstructions"—railroad travel might be safer:

Colonia, June 20, 1881.

Mr. McGee, Conductor,
Mr. Tate, Engineer.

I think the best time for you to leave Colonia for El Salto will be 2 p. m., crossing with the other train at Lecheria. Run without any objections or obstructions. Good for two days. F. Larenos,
Chief of Traffic.

On the West Iowa division of the C., B. & Q. a marked improvement in the coal consumption has been noticed since promotions were made on record, especially coal record, and seniority has cut a smaller figure than it used to. Enough coal must be burned to do the work; still the men can save more coal than all the compounds ever invented, if they try.

In the Northern Peninsula of Michigan.

[Editorial Correspondence.]

The snowy, lake-bound country on the south of the great Lake Superior, and north of Lake Michigan, is not much visited by railroad newspaper men—it's too far away, and there is not an advertisement

On the Mineral Range, April 18th. Man on Left is Conductor John Shields, now Supt. and M. M. of the Narrow Gage System.

to be had—but Locomotive Engineering has several big lists of readers there, and the J. P. wanted to see the country, anyway. I'll tell you about lower Michigan in a different way and some other time, and start in at the Straits of Mackinaw, and take you around toward Duluth—"the zenith city of the unsalted seas," as Proctor Knott named it.

I landed at Mackinaw City, in company with Mr. James E. Keegan, the genial general master mechanic of the Grand Rapids & Indiana, over whose road I traveled north through the depleted timber country.

Mackinaw is a straggling saw-mill town on the decline. There is an old fort there, a lighthouse, and a weather bureau—a fort was established here by the French in 1671.

Here I met M. M. Meehan, traveling engineer of the Duluth, South Shore & Atlantic, got some breakfast and went aboard the transfer steamer *Sainte Marie* to cross the Straits of Mackinaw to St. Ignace. The straits are some seven miles wide—the clear, clean waters of Lake Michigan on their swift course to Lake Huron.

The *Sainte Marie* is the larger of two boats owned by this railroad, and especially designed to break ice. They are very large, have a screw at each end, and their timbers are much heavier than an ocean-going ship. The forward screw is run by an independent engine, and in summer this engine is shut down and disconnected from the shaft—the screw then turns idly by the force of the water. When ice appears two engine crews are put on, and they proceed to "buck ice."

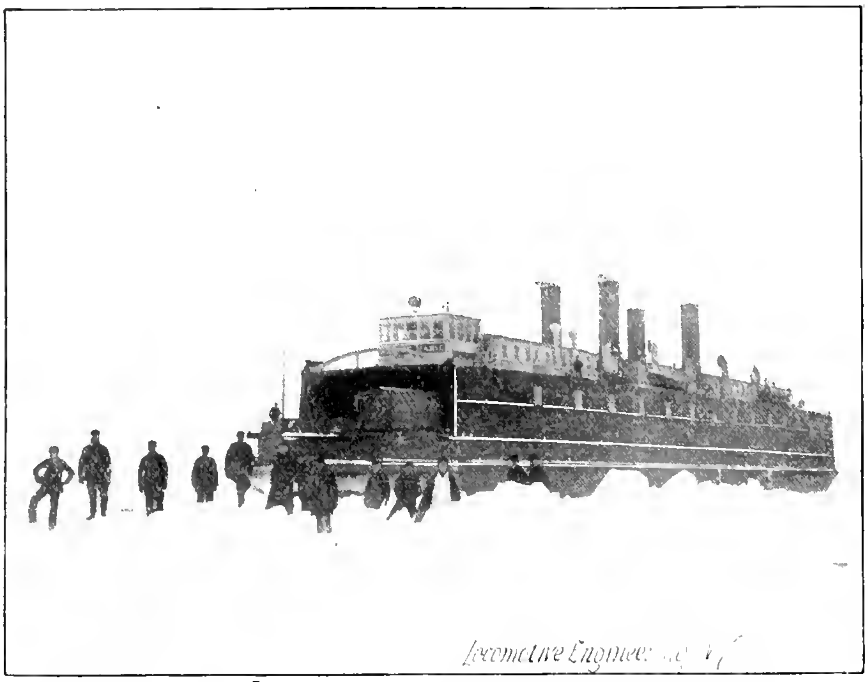
Our photograph shows the boat at work in ice; she has made progress in broken ice twelve feet deep. Her nose is not of the ram shape, as a layman would expect, but slopes from a point a little below the water line back on the keel; she breaks ice down and forces herself over it.

Chief Engineer O'Neil showed us all over the "down stairs" of the big boat, and then we were invited to ride in Captain Boynton's pilot house.

Landing at St. Ignace, we bid good-bye to Mr. Keegan, who had come across with us, and got on board a D., S. S. & A. train that was in waiting.

St. Ignace is a small place with ore and coal docks. Like most of the other lake towns, it was settled late in the 1600's by the French Jesuits; here, in the yard of

Mr. Meehan's father-in-law, is the grave and monument of the pioneer priest and discoverer, Father Marquette. He settled Sault Ste. Marie in 1668, the first white settlement in Michigan. Of him, Longfellow wrote:



THE SAINTE MARIE BUCKING ICE. PHOTOGRAPHED AT ST. IGNACE, DEC. 14, 1894.

"And the noble Hiawatha,
With his hands aloft extended,
Held aloft the sign of welcome;
Waited, full of exultation,
Till the birch canoe, with paddles,
Grated on the shining pebbles,
Stranded on the sandy margin—
Till the Black-Robe Chief, the Pale-Face,
With the cross upon his bosom,
Landed on the sandy margin."

From St. Ignace to the big "Soo" the road goes through a rather bleak country. Millions of feet of lumber have been cut off here; fires have killed much of the young timber, and the land is poor and the country uninviting.

There was good sleighing at Sault Ste. Marie; every boy in town had a dog sled, and the electric cars were tied up for the winter—no Rotary.

The "Soo" Line comes in here, and there is a very fine steel bridge across the straits (or river) to Canada, connecting the roads of North Michigan with the Canadian Pacific—which controls them.

The Sault Ste. Marie is St. Mary's River, in English; this river carries the waters of Lake Superior to those of Lake Huron. The river is 60 miles long, and enters Lake Huron by a number of channels. At the town of Sault Ste. Marie there is a rapids where the river drops 20 feet in a half-a-mile, and a ship canal has been built on the United States side to let vessels around the rapids.

The locks are very large; the machinery all handled by water power. There is nearly completed here the largest lock in the world, and a new canal is cut to it; it will probably be opened next year. Our picture of the *North West*, the largest vessel afloat on the Great Lakes, was taken while she stood in the present lock.

The road has a small roundhouse here, and the foreman took his solemn oath that the North Pole was "just over there by the lighthouse," when I asked if it was cold in winter.

We rode from the "Soo" to Marquette in the dark, and I know little about the country, but I found out that Meehan was a capital story teller.

Marquette is the port of the iron country lying adjacent to it; great ore docks are here, where whole train-loads of iron ore are dumped into chutes and from these shot directly into vessels for the Eastern markets. A large steamer can be loaded in less than an hour.

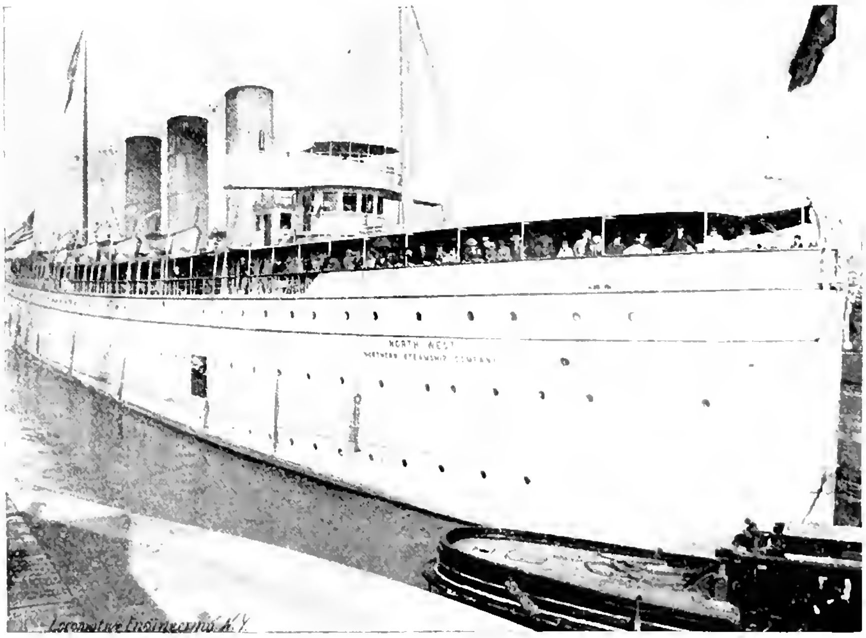
The D., S. S. & A. have very extensive yards here for the ore business. It is, however, strictly a summer business; the last boat was loading the day I struck town; then business in the ore line will be dead until the opening of navigation.

The headquarters and main shops are here. The shops are substantial brick and stone buildings; there are none too many tools; in fact, I could not help wondering all the time how Superintendent of Motive Power J. J. Connolly keeps his power up in such good shape as he does.

The power is quite varied; the picture shown herewith represents very fairly their mogul freight engines.

Evidences of snow are everywhere, every engine has a large pilot plow on and flangers. A rotary plow stands out in the yard, together with numerous other breeds of large plows. They have one snow handler called "the Crab," the like of which, I have little doubt, could not be found anywhere else. This is a machine for *putting snow on the track*.

This machine is a home-made affair attached to a flat car. It has huge wings that can be spread out, scraping in all the loose snow within four feet of the tracks,

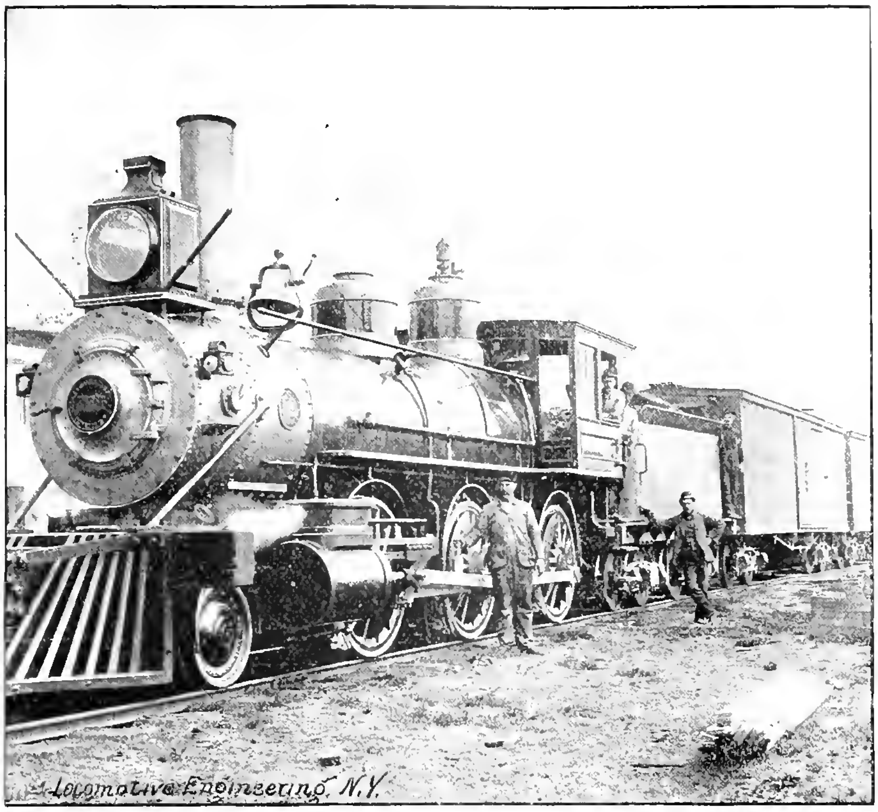


LARGEST STEAMER ON THE LAKES, IN LOCK AT SAULT STE. MARIE.

and making a winrow of it right in the center of the track. Then the Rotary is run through and throws the snow clear of the right of way. It is pulled by a long timber, heavily ironed, which allows it lots of room to cut a wide swath. It is a first-class thing to clean up a yard with or to follow wedge plows.

While out in the yard, I want to mention

an ingenious ditcher they have made here. This also is a flat car attachment. Across one end of the car is arranged heavy timbers, projecting six feet on either side, and so constructed as to fold out of the way for transportation. From these timbers



MOGUL FREIGHT LOCOMOTIVE OF THE D., S. S. & A.

the ditcher scoops are dragged by chains. The scoop is simply a trough of iron, open at both ends. To the back of the scoop, on either side of the car, chains go to an overhead framework, and are there handled by air cylinders.

By pulling the car along a place needing ditch work, like a cut, the operator can make the scoop "bite" by raising the back end, same as in using the ordinary road scraper; a few trips like this in a cut where the ditches are half filled with sliding mud, and the effect is wonderful. To clean out ditches that are partially filled up, they use the same car to drag an old pair of car wheels, on the axle, through the ditch lengthwise. This has been found to do the business in first-class shape and very quickly.

There are a good many such rigs around that the men have gotten up to handle emergencies in snow and slush, and General Manager Fitch is prouder of them than anything else.

In the car shop I noticed Mr. Fitch's private car; on each back corner there hangs a piece of sheet metal, going around the corner of the car, reaching from the hand-rail up above the windows. The front of this sheet, on the side of the car toward the engine, is slightly bent out, perhaps 2 inches of opening, and the opening between it and the end of the car is only about $\frac{1}{2}$ inch; this makes an automatic air jet that blows all the snow off the rear windows, and does it thoroughly. Anyone who has tried to watch the track from the rear of an officer's car at high speed, with loose, dry snow flying, could appreciate this kink.

By the way, they have a sensible way of not striping their coaches, and they paint the ends jet black. By this plan they are able to keep their coaches out longer, for it's the ends of cars that get blackened up and dirty. They have one train with the coaches all painted black, and a good looking train it is—it's known locally as "the black express"—but some of the officers think it looks too much like a string of hearses.

In the back shop I noticed they were making and putting in a good many new driving-wheel centers—the old ones have been breaking the crank-pin bosses.

They have had a good deal of trouble of late with flat tires, and the usual causes have been discussed, counterbalance, too close cut-off, etc. I noticed some tires, however, that were freshly turned, and they had never been flat, and the turning developed soft, spongy places in the interior of the tires. I noticed one hole, apparently a blowhole, $\frac{3}{8}$ inch long, $\frac{1}{8}$ inch deep. Undoubtedly, that tire will soon have a flat spot—and this time the counterbalance will not be guilty.

They have had considerable repairs on all engines coming into the shops, as they are replacing a pretty full equipment of steam driver brakes with air brakes.

I have heard of pretty good records for balanced valves, but the ones in common use here do better than the best I have heard of. They have passenger engines in regular service that have not had their chest covers off in four years. They use the regular Richardson balance.

I noticed that they used a heavy key in all their center-pin bolts for pony trucks, and was told that they had never had a broken bolt since it was adopted; with the old threaded bolt they had frequent breakages—as they do almost everywhere they are used.

SUMMER IN THE COPPER COUNTRY. MINERAL RANGE SPECIAL AT SCENE OF $75,000 EXPRESS ROBBERY, NEAR LOSTON STATION, LAST YEAR.

Engine "100," Wm. Green, engineer, has a record. She was just coming out of the shop when I visited Marquette. She had run 254,418 miles without general repairs, did not have steam chest covers off in that time; made a grand average of 47.34 miles to the ton of coal, 110.95 miles to the pint of valve oil and 37.82 miles to

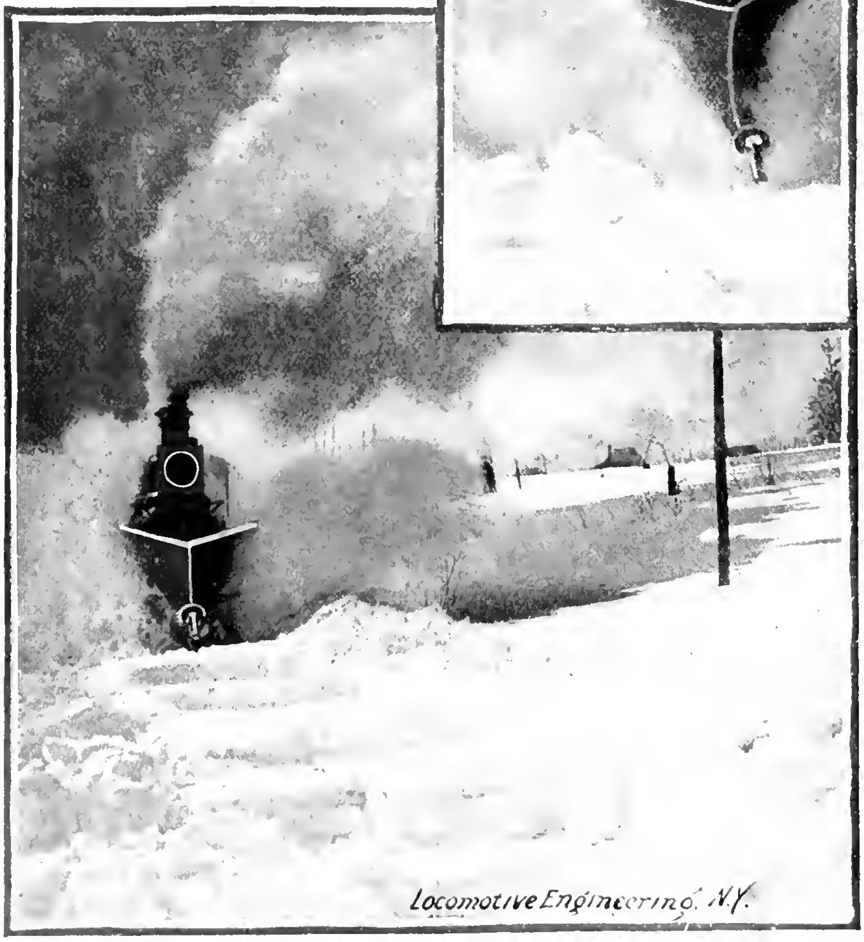
the pint of engine oil. During all the time she was in passenger service, pulling an average of four coaches on varying grades—some of which are 158 feet per mile. This is a record to be proud of, both by the officers of the company and the engineer and fireman.

Foreman Blacksmith Kelly is an ingenious man, and has some home-made tools that are very efficient — he promised sketches of them to the readers of LOCOMOTIVE ENGINEERING.

The flangers used are simply huge chisels on the front of the pilot plows, the handle is connected to a tumbling shaft on the buffer beam, and the flangers are raised and lowered by air. A little cross is erected at every crossing or frog to notify engineer when to lift his flanger.

At every switch there is a post, and on it is hung a shovel and broom, to clean out the switch rails with.

Every engine has a snow house over the tender. These houses are boxes built up straight just inside the flange of the tank, just as high as the cab in front and sloping down to about three feet at the rear. On top there are trap doors opening from the center each way. They are short enough to stop just in front of the manhole. A man can get out on top quickly. They do not interfere in taking coal, and they keep out the snow and cold. The doors do not quite reach to the cab and across; and tacked both to the cab roof and the front of the box, they put a strip of old aisle carpet from the coaches. Double side curtains are used, and, taken altogether, the men are pretty well provided for comfort in severe weather—of which they have enough and to spare.



SNAP SHOTS ON THE HANCOCK & CALUMET. "DITCHED" SNOW AND ICE—TAKING A RUN AT IT.

I picked up some kinks here and elsewhere on the road, but it would string this article—already too long—to interminable lengths if I incorporated them here, so I will move along and try and interest you for ten minutes about the

COPPER COUNTRY.

If you look at a map of Michigan you will notice a strip of land sticking up into Lake Superior like a sore thumb—that little strip of dirt is worth almost as much as the rest of the State.

Here are located the famous Calumet mines—the Lake Superior copper mines, the output of which is so great as to control the market of the world; where the deepest underground workings are to be found, and where the hoisting machinery is the largest and finest in the world.

A branch of the D., S. S. & A. reaches up to Houghton, and from there extend into the copper country two narrow-gage roads—the Mineral Range, 17 miles long, and the Hancock & Calumet, 21 miles long—part of this mileage is branches.

The first-named road was opened in 1871 and the latter in 1885; both are now under control of the D., S. S. & A., and operated together as a belt road. These two properties, though stocked and bonded to the full extent of the law, have been earning over 40 per cent. *net* for some time.

They use ten-wheel passenger engines and consolidation freight engines, handle a big tonnage and do a nice passenger business.

The general office building at Hancock is good enough for a trunk line road; the old general officers used to put on some style, but the shop, which is almost under the same roof, is the dirtiest and meanest I have seen lately—less said about that the better.

The enginemen are a fine set of men, and have been for years doing lots of work at very small pay. How a road doing such a business, making so much money and supporting officerships at \$6,000 to \$10,000 a year, could keep engineers at work for from \$60 to \$100 per month, is more than I can see. They keep their engines in good shape, handle the air well, and stand awful weather and deserve standard pay.

The road, or rather roads, have been run without any records whatever—the men never knew, until this year, how much coal and oil they used—but things are getting to a system now and main line methods will soon be the vogue.

Up at Calumet, where the mines are, there is the most unique road in North America. It is down on the railroad lists as the Hecla & Torch Lake R.R.; it is 6 miles long, and has a branch $3\frac{1}{2}$ miles. It is owned and controlled absolutely by the Calumet & Hecla Copper Mining Co.

Its gage is 4 feet 1 inch, and it owns 9 locomotives and about 400 cars, almost all four-wheeled ore cars. Its entire business is to get out and take from Calumet to Lake Linden, 6 miles, the copper ore for the great stamp mills located on the lake. The road was chartered and built in 1868.

We show some pictures of their locomo-

tives; quite a number of Mason-Fairlie engines are used and two big Wootten's. One man runs both Wootten's—one is in the shop while he runs the other.

These engines have a peculiar device under the firebox and back of the wheels, that is employed to guide the engine when backing up, by rigidly fastening a connection to the tank trucks, making them act as guiding trucks; this can be thrown into or out of service by use of a lever. It is the invention of the superintendent, Mr. W. A. Childs.

In the picture we show of this engine, can be seen the engineer, John Lang. He makes seven trips to Lake Linden every day, hauls at each trip 36,000 tons of ore, and has been doing this for eighteen years—perhaps more freight than is handled by any other man in America.

The engines are kept up in the best possible shape, scraped joints are everywhere, enough of everything is forthcoming to do with, and cleanliness is the rule. Oil of the finest quality is lavishly furnished and used. This Wootten engine gets more valve oil in one trip than is allowed per hundred miles on any road I know of.

In the roundhouse they use clean sawdust along the pit rails to keep oil from dirtying the floor, etc.

By permission of the manager we rode from Calumet to Lake Linden on the engine; the grade is close to 200 feet per mile and not extra straight.

At the lake is located the largest steam stamp mill in the world, where the copper ore is crushed and washed, and loaded into iron cars, looking like copper sand, and hauled a mile away to another plant, where it is melted into bars and ingots—but what do you care about copper mines?

I will say this, that if anyone wants to be interested in every conceivable way, a summer trip to the copper country would beat a trip to Europe 100 per cent.

Meehan and the J. P. went back to Marquette to get a fresh start, after two days in the copper country, and took a sleeper for Duluth. Mike said I wasn't missing anything by not seeing the country between Houghton and Duluth, and from what I saw of it for fifty miles out of Duluth the next morning, I was inclined to agree with him.

J. A. H.

Hard Man to Fire For.

"Wassematter, Swifty?" asked the chipper fireman of his room mate, as the latter came into the roundhouse looking for all the world as if he'd been tied to the rear sleeper and dragged over the road.

"Tired," was the laconic reply.

"Tired! You tired firin' passenger only four hours on the road? Why, I've been on freight twelve hours, and feels as fresh as a daisy."

"Mebbe you do, Swipesy; but you ain't a firin' for a long-geared, lanky galoot that goes over the hull road *a-draggin' the links on the ties!*"

Pop Valve Reminiscences.

BY F. F. HEMENWAY.

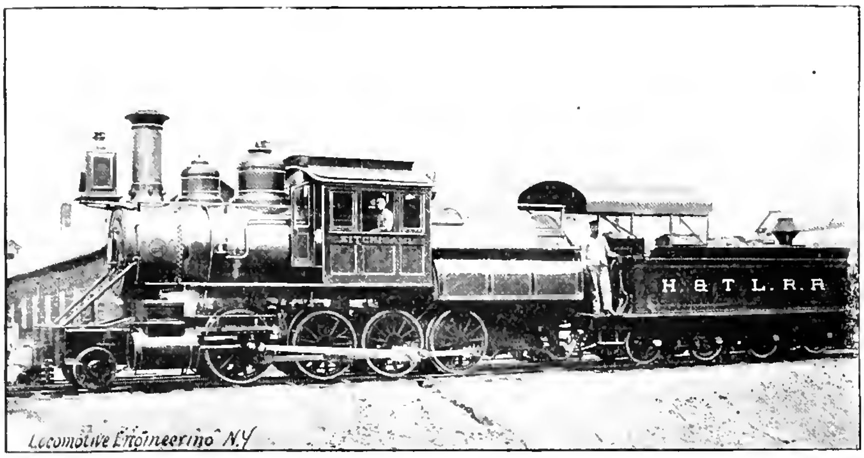
In 1866, Geo. W. Richardson invented what has since come to be universally known as the pop safety valve. It was christened by enginemen, the word safety being omitted, getting its name just as many another thing has got its name. When a name comes in this way, it would be an easy matter changing the laws of the ancient Medes and Persians compared with making any change in its name. The valve got the prefix "pop," and a little later on Richardson was universally known amongst Eastern railroad men as Pop Richardson, not by any means because he was old—he was scarcely in the prime of life—but for the purpose of definitely connecting him with his creation—the pop valve. Richardson, as I happen to know, was secretly pleased, up to the time of his death, at the front name the boys had given him. It was given with hearty goodwill, and there was no question about its distinguishing him from all other members of the various Richardson families. Probably most of us would have been pleased with the name if it came under the same circumstances.

Richardson was proud of his invention of the pop valve, proud of the name the boys gave it, and proud of the name they gave him. I am not sure but he was prouder of one other invention of his, and that was something that never came to anything, and probably never would have come to anything with the best of opportunities in its favor. This invention was a submarine gun which he devised about the time of the strained relations between what were then known as the North and the South. Of course, to go with this gun, he invented a boat, that he believed could be operated at any depth of submersion. He never built the boat, except on paper, but he did build the gun. He did build the gun, and incidentally a long trough of quite considerable dimensions. Filling the trough with water, and fixing the gun near the bottom of it, he would let it re-

HANCOCK & CALUMET R.R., APRIL 1, 1893—NEAR ALLOUEZ STATION. SNOW OVER THE TELEGRAPH POLES, TUNNELED TO REPAIR THE WIRES.

main submerged till morning; then fire it at a target.

He had full faith that with his engine of war he could annihilate a hostile fleet, by attacking it, piece by piece, so to speak, and perhaps he could—no one can say to the contrary—if he could have had the opportunity of working out his schemes. But he had no money with which to push his invention, and, mechanic-like, when he had made up his mind a thing would work, that was almost satisfaction enough. If someone else could not see it his way, why it was unfortunate for someone else. Not that he was conceited; I know to the contrary of this by years of experience. But when a mechanic—and Richardson was a mechanic if ever there was one—has studied his plans and formulated his conclusions, he does not change them for the first breath that blows contrary to his opinions.



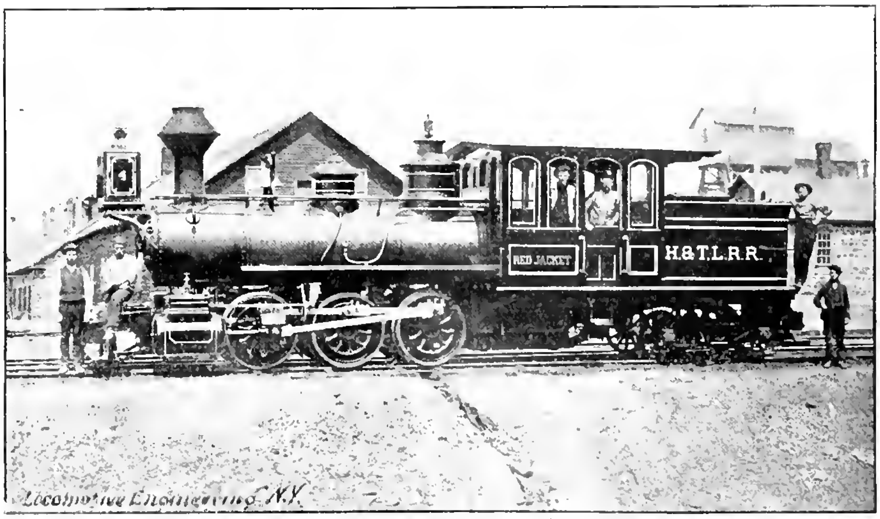
Hecla & Torch Lake R.R., 4 Foot 1 Inch Gage, Wootten.

But to cut this short, Richardson lacked capital, and he entrusted his drawings to a man who had "friends at court," in other words, to some one who, presumably, could bring the matter before the Navy Department, and from the endorsement of this department he could, so he thought, and so he was promised, get plenty of backing to push the submarine gun project.

But the matter miscarried, and somehow, in a short time Richardson saw his invention patented by another party. The whole scheme was so identical with what he had done and described, that there was not the least doubt but the drawings had gone astray, as often happens in such cases.

In new hands it turned out to be worthless, but Richardson always insisted that it was because the fellow who did the stealing did not know enough to copy. That may or may not have been correct judgment in this particular case, but generally speaking it is likely to be true. You can copy lines and plans and projections, but copying brains is quite another thing. If there was anything that Richardson ever felt more proud over than the pop valve it was his submarine gun, and it comforted him wonderfully that, inasmuch as he had no money with which to push the matter in the courts, the "other fellow" did not know enough to make his scheme work.

But this is digression. At the time Richardson sprung his pop valve on railroad mechanical practice there was not any particular enthusiasm in regard to it. Everybody knew that the types of safety valves then in use were entirely inadequate to the demands of the larger engines then coming into use. The prevailing type was the old-style valve, held down by the Salter balance. Everyone familiar with the subject knows of this or similar valves. They will give warning of an intention, or at least a willingness, to blow, if somebody helps them. That is about all, and this inherent weakness shows up prominently with the modern locomotive boiler, with its marvelous steaming capacity.



Mason Fairlie at the Calumet Mine.

I remember, one time, going with Richardson to witness the operating of the safety valves on a—for the time—large locomotive. This was after his patent was granted, but before he had made much progress in introducing his valve. The two safety valves were each three inches diameter, with the traditional Salter balance. The engine was handling freight on the hill, and was worked for all there was in her. While working at her hardest, with about two tons of incandescent coal in the furnace, the occasion came for a sudden stop, which temporarily engaged the attention of both engineer and fireman; there was trouble right ahead, and not far off. You had scarcely time to turn around before the boiler pressure had gone up 20 pounds beyond the limit, or the supposed limit, and the valves were not complaining much at that. Then the engineer turned his attention to the matter. He put in a wooden wedge, or two, around the Salter arrangement—either that or he took out wedges, probably the latter—and then the pressure gradually subsided.

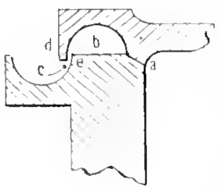
Of course, nothing could suit Richardson better than this. It was an object lesson. When we got back to the shops he proposed to the master mechanic to put in two of his valves, each $2\frac{1}{4}$ inches in diameter, set them at the required pressure; then, if by any kind of firing the pressure was increased by one pound beyond the blowing point, there should be no charge for the valves.

The master mechanic, a whole-souled fellow, accepted the proposition, and made merry over his prospects of getting two pretty good valves for nothing. Richardson won, with pretty nearly one valve to spare. At that time he needed the money for these valves as much as ever needy inventor did; but the money consideration was the last thing he thought of. The pride of the mechanic, every bit as strong in his achievements as the pride of the warrior or the statesman in his, came to the front. He had achieved mechanical success, and that was enough for the present.

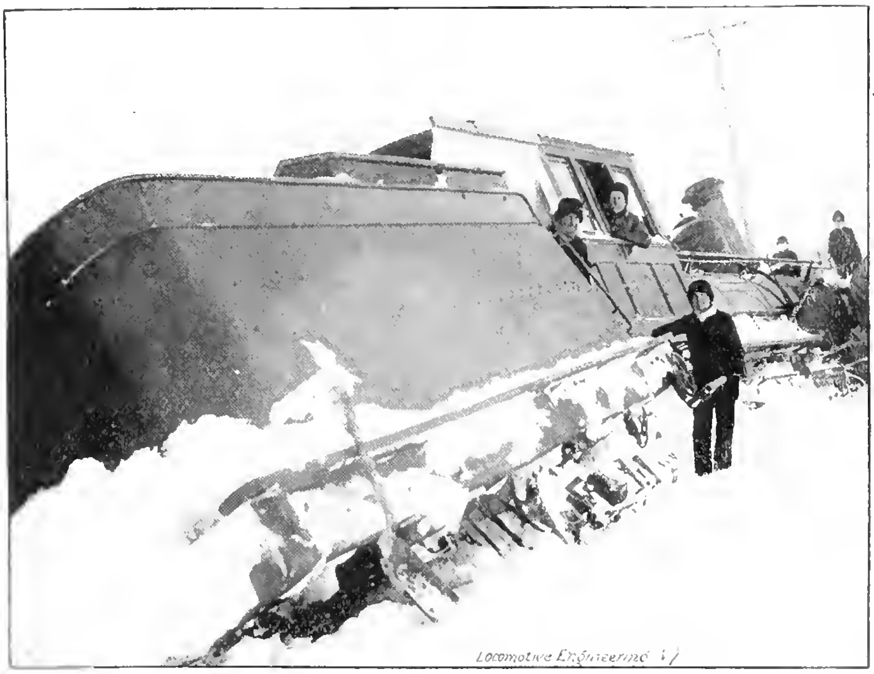
But this is running a little ahead of the story. As Richardson first essayed to use his valve, he would have been beaten in this contest. His idea was to replace the 3-inch valve in common use by a bush and his $2\frac{1}{4}$-inch valve, retaining the Salter balance substantially as used before. It would not

work satisfactorily. The first Richardson valve ever applied to a locomotive boiler was applied to the locomotive "Walloomsac," on the (then) Troy & Boston road. The whole work of making and applying the valve was done after everyone had left the shop at night. It worked better than the old valve, but not very much better, or at least not so much better as was anticipated. Then the experiment was repeated, with less of secrecy, on one of the largest locomotives on the road, the "J. V. Baker," built at Schenectady. With all the pains that could be taken with the pins, lever guides, etc., it became apparent that there was too much friction for the valve to combat successfully; in fact, it became apparent that friction must be obliterated—wiped out entirely. Richardson's patent had contemplated a spring above and acting directly on the valve, without the intervention of levers, and that must, evidently, be the outcome.

Logging on the Hancock & Calumet. Photographed April 1, 1894.



Although Richardson's valve is so well known amongst railroad mechanics, I will venture to introduce a sketch of a little fragment of it here, as made in its earliest form, prefacing its introduction by saying that, although it has been slightly modified for convenience of adjustment in certain particulars, this little fragmentary sketch, which is made entirely from memory going back fifteen years, and without any attempt at proportion of parts—will serve all purposes. The principal features—the construction so far as the accomplishment of definite purposes is concerned—have never been varied. There was never any occasion to vary it. The sketch is simply for the purpose of pointing out some of the difficulties of rearranging the valve from the use of the Salter balance, with its entailed friction, to the direct spring pressure, devoid of friction. But since the sketch is here, it may not be amiss to give a brief explanation. There may be some who are still unacquainted with the principle involved. The steam, after leaving the ground seat *A*, which it will do as soon as the point of blowing off is reached, expands in the cavity *B* of the overhanging part of the valve, which provides an increased area for the steam to act upon, thereby overcoming the increased tension of the spring and lifting the valve to a considerable height, permitting free escape of steam from the boiler till the pressure is slightly reduced, when the overwrought spring, relieved to a slight extent, returns the valve to its seat.



Mineral Range R.R. Too Much of a Good Thing.

It is plain that if the steam had free exit from cavity *B*, nothing of the kind mentioned could occur, because there would be no pressure in that cavity; hence the restricted opening at *C*. This restricted opening, it will be observed, is the result—first, of the overhanging lip *D* of the valve projecting below the surface *E* of the bush; and second, by this lip approaching very near the horizontal surface of the bush. This narrow passage at *C* was called an opening, until in later years the lawyers and experts got handling it; then it was, quite properly, called a stricture. Its object is to retain some pressure in chamber *B*.

Now, it was evident that there must be a rather definite relation of pressure in chamber *B* to the stricture at *C*, and to the spring that was to hold the valve down. There may be some mathematician who could have figured this all out, but one has a right to doubt this. At any rate, it was all brought out by tentative processes and without serious trouble. Sometime later, when it was of no particular importance—it never would have been—the pressure in various parts of chamber *B* was determined with great exactness; but this was for the assumed edification of judges, and not as an advantage to the mechanic or engineer.

The proportions, as indicated by experiment, were—for the locomotive size of valve, and with the prevailing pressure—a spring wound from $\frac{3}{8}$-inch square steel on an arbor $1\frac{3}{4}$-inch diameter, the spring to have seven coils and to be $4\frac{1}{8}$ inches in length. But this was only the beginning. The best English steel in American markets was selected—"Yankee" steel was at a discount at that time—but the springs made from this English steel would not stand up to the pounding they got for

more than a short time. They would either break or weaken. Richardson himself knew how to make a spring as well as anyone I ever knew, but he exhausted all his arts in vain. And this was true of others. Finally, a Pittsburgh brand of steel was brought to his notice, the manufacturers of which offered to fulfill all requirements if only a little patience was exercised; send back, was their urgent request, any but that which acts right, and after two or three trials we will give you just what you want. They did so, and I presume are doing so to this day.

It is no more than fair to assume that English manufacturers could have done the same with equal advantages. Their steel was simply bought from stock, and no one knew whether it was peculiarly calculated for springs, or anything else in particular.

After a spring that would stand up like the spring of a chronometer had been—as it was hoped—found, it was determined to give the matter a practical test. Reference has been made to the engine "Walloomsac" that had been fitted with a pop valve, the old Salter balance being retained. The Salter balance was scrapped and a valve put in with one of the new springs directly over it. The spindle of the Richardson valve, as is well known, rests on a point near the bottom of the guiding wings. This hole was continued a little deeper, and a suitably formed hardened steel stop put in place. This was for the purpose of eliminating wear, just as far as possible. The steam gage was tested, and the valve set to blow at 125 pounds by its indications. At the end of just about one year the engineer, a careful man, reported the safety valve out; could not carry the steam he was entitled to. The gage was taken down and tested, found to be wrong, set right, and put back. Then the valve was tried, and if it had gone wrong at all, it was within the limit of one pound either way. This, after blowing thousands of times, was the most complete vindication of a spring I ever remember to have heard of.

The pop valve had gained a solid standing on railroads. It, so to speak, worked its way along them itself. Some States, notably New York and Ohio, had enacted laws requiring lock-up valves for stationary boilers. Richardson's valve was particularly adapted to being locked up, so he started, at first with a 2-inch encased valve, to comply with the law. The spring was proportioned from experience with the spring for the locomotive valves, and other parts proportioned accordingly, as near as might be, taking steam pressure into consideration. In order to test the operation of this valve, a 3-inch gate valve was placed on the dome of a stationary boiler located in rather close quarters, and a 2-inch pipe was extended up through the low roof, to the upper end of which the pop valve was attached. Spring, stricture and everything connected with it had been worked out with the greatest care.

Presumably there was nothing to do but to open the gate valve and hear it go. The gate valve was opened, and when the pressure in the boiler came up to the blowing point there came from that 2-inch encased valve such a succession of shrieks as no one thereabouts had ever before heard. The valve simply lifted from its seat, and closed tight about four hundred times a second, each successive shriek being, in fiendishness, an improvement on its predecessor. This lifting and closing it kept right along with until the boiler pressure was reduced by about two pounds, then the valve settled to its seat as quietly as if it had never aroused the whole neighborhood. As in the blowing the pressure became slightly reduced, there was what the musicians would call a difference in tone and time, but no improvement so far as the resisting powers of the ear were concerned. It was the devil's gamut, sure enough. After that valve settled down at the conclusion of one of its demonstrations of the infernal, it just gathered up its latent powers for another. There was never anything better about its operations. One was never better than another—simply a little worse.

Richardson was going West the morning the new valve was to be tried. He had barely time to hear it blow twice, when with a hurried injunction of "Fix it, Frank," he left. It was a cheerful outlook. But it must be "fixed," sure, or a rather important outlook for business was lost. A couple of days after, came this telegram from Richardson, then at Chicago: "How is the buzzer?" Modesty, and the fact that the authorized version was not in use at the time, forbids a remembrance of the reply.

But the valve must be made right, that was certain.

By looking at the sketch, the reader will observe that various changes could be made in the stricture *C*. The lip could be let down lower, or it could be cut off so as to be shorter. The stricture could be made wider, transversely, by turning out, or it could be made narrower by burnishing in the lip, all of which will be readily understood. All these processes of presumable reformation were tried; tried in combination and tried separately, but the result always seemed something a little worse.

But finding out what will not serve a given purpose is sometimes going a good ways towards finding out what will serve it. Might not the spring be at fault? There must be correlation between the spring and the amplitude of the stricture at *C*. The stricture had all been gone through with. What, then, but the spring could be at fault? Springs were made; springs heavier and springs lighter, springs longer and springs shorter; but all to no purpose.

Finally, as a last resort, and without much in the way of hope, the valve, with its original spring, and restored as nearly as could be to its original condition, was placed directly on the 3-inch gate valve on the dome. At the first trial, it performed its work just as if it had never acted in any other way than a well-regulated pop valve ought to act.

The simple fact was that the valve could not stand the pulsations of the steam in that 2-inch straight pipe, scarcely more than 6 feet in length, although the opening in the valve bush was only 2 inches, and that was partly blocked by the wings and the central part of the valve. There may be a lesson in this quite outside safety valves; at any rate, so far as the matter in hand went, no repetition was needed. The moral was plain.

It has been said that, as originally made, the pop valve stood directly exposed to the atmosphere; no encompassing case or noise-distributing muffler. When it blew it was a direct war with the encompassing atmosphere; a war to the end of producing the greatest possible noise—tumult. And there was no warning as to when this noise would occur. While getting the first "blow" out of a valve in some rickety old roundhouse, it almost seemed as if the roof was coming down to meet you. It seemed always to come about that you had to do this at night, with two or three dilapidated petticoat lamps standing here and there as sentinels of darkness. Many a time, where the valve was not known, when it let go for the first time, it would send the wipers scurrying from the pits, and not infrequently dignified master mechanics would hunt for the door.

Locomotives Built Last Year.

Locomotive building is shown to have fallen off tremendously in the past year, according to our reports of the output of the various contracting works. The decrease in the number built is fully two-thirds, as compared with the previous year. Reports from thirteen companies make the total 695 locomotives for 1894, against 2,011 locomotives built in 1893. Three companies building nearly 90 locomotives in 1893, did not turn out a single new locomotive in 1894. Of course when the general totals show such a great decrease, it is not to be expected that any one manufacturer would be fortunate enough to build anything like his previous year's work. As a matter of fact, no one company built half as many locomotives in 1894 as in 1893, and only the smaller builders were able to keep within a third of the output recorded for 1894.

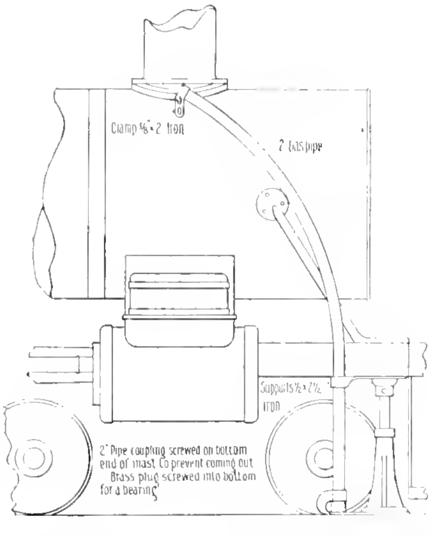
These figures are unprecedented in locomotive building in the United States. Going back five years, we get the following record of locomotives built in the United States: In 1894, 10 companies built 695 locomotives (3 built none); in 1893, 14 built 2,011; in 1892, 13 built 2,012; in 1891, 13 built 2,165; in 1890, 15 built 2,300.

It is to be noted that over 80 locomotives of the total number built in 1894 were built for export.—*American Machinist.*

A Neat Roundhouse Crane for Steam Chest Work.

The engraving shown herewith illustrates a neat little crane for handling steam chest covers, seat planers, valves, etc., made and used by General Foreman George Glaser, of the C., M. & St. P. shops at Portage City, Wis.

The mast is made of a 2-inch gas pipe, bent as shown, with suitable connection at the top to couple lifting tackle to. On the bottom end is screwed a coupling; this prevents lower end from lifting out of the support, and a brass plug screwed into the



coupling serves as a pivot for the mast to turn on.

The top and bottom bearings of the mast are held in position by an ordinary screw-jack, in the manner shown. This is an ingenious scheme, and saves lots of traps, bolts, etc. Any jack can be used, and the crane itself consists of one crooked piece of pipe and two light loops of band iron fast to it. One man can carry it anywhere.

The practice that a few heads of mechanical departments of railroads have followed of calling periodical meetings of master mechanics, master car builders, foremen and others, to discuss matters relating to the care and operating of railroad rolling stock, has been adopted by Mr. R. C. Blackall, of the Delaware & Hudson. He asks his men to send in questions which ought to be discussed, and they are taken up in the meetings, and every one present is expected to express his views.

The Interstate Commerce Law, which calls for the equipment of railroad cars with safety appliances, will require railroad companies to make heavy expenditures this year. The officers of one railroad, which has been noted for keeping up the equipment, have made calculations that they will need to spend over one million dollars this year on air brakes and couplers. They have about 13,000 cars.

Six and Eight-Wheeled Tenders.

BY W. F. DIXON.*

There has been more or less discussion during the last two years as to the merits of the six-wheeled European type of tender as compared with the eight-wheeled or double truck form so widely used in this country. As a few of the former have recently been put in service on a couple of our Eastern roads, it seems pertinent at the present time to look somewhat carefully into the matter, and to try and decide whether mere personal opinion and individual preference and the blind following after an established lead have been responsible for the practice of nearly every road in the country, or whether there are certain qualities peculiar to the American form of tender which cannot be successfully dispensed with under our conditions of railroad operation.

It has, apparently, caused some of our English friends a good deal of pain blended with amusement, that we have been so indifferent to our own interests as to perpetuate the eight-wheeled tender after they had pointed out its weak points to us exhaustively through the medium of their technical press, and it is now a cause of congratulation with them that we have, at last, built a few tenders embodying the most essential of the European features.

The chief points of superiority claimed by its advocates for the six-wheeled tender over the eight-wheeled, are greater accessibility, greater simplicity, less dead weight per unit of capacity, less first cost and smaller cost of maintenance. If these very important points can be substantiated they, of course, constitute the strongest kind of an argument in their favor, providing, however, there are no really serious objections to offset them.

The American locomotive, in open competition with that of other nations, has won an enviable position for itself in many parts of the world, including some of the British colonies and countries under a British protectorate, on account of its flexibility, general get-at-ableness and low cost of maintenance, features which are especially valuable where railroads have to be built at a minimum cost per mile and operated at a correspondingly low figure.

The admitted reason of its flexibility is

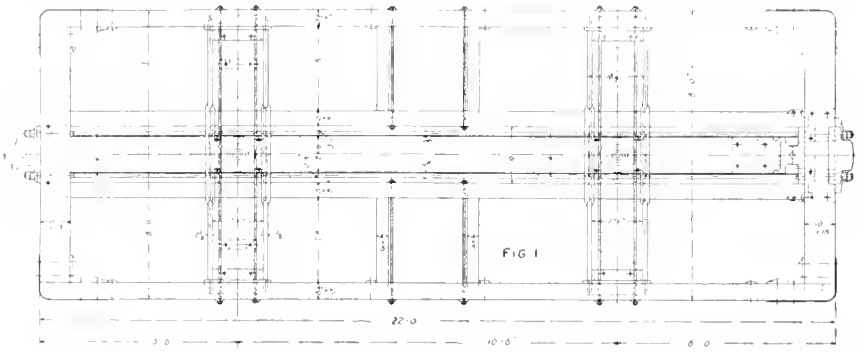


FIG 1

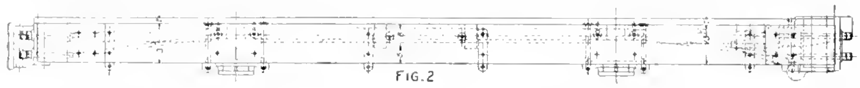


FIG. 2


FIG 3

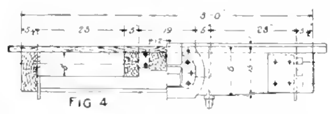


FIG 4

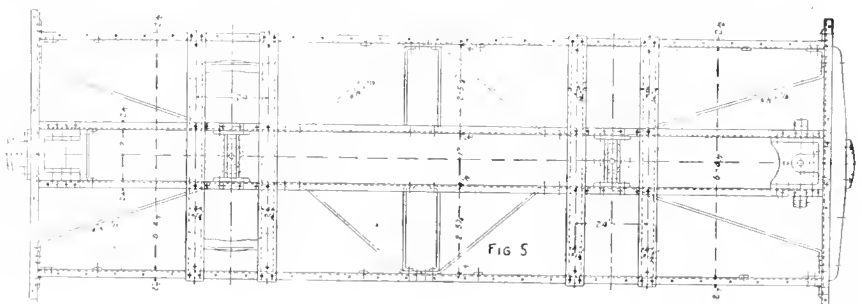


FIG 5

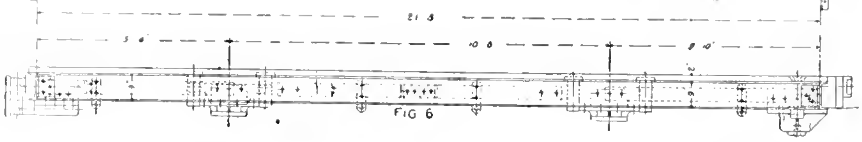


FIG 6

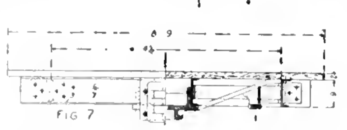


FIG 7

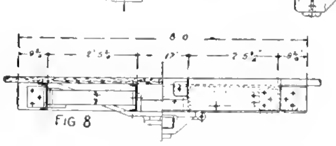


FIG 8

*Chief Draftsman, Rogers Locomotive Company.

the free employment of equalizing levers between the carrying springs, arranged on what is commonly known as "the three-legged stool principle," while its accessibility has been obtained by carefully avoiding covering up the machinery by sheet-iron covers, running plates, etc. The results of this latter are, perhaps, not so pleasing to the eye as the smooth, unbroken lines presented by a typical English engine, but after all, being accustomed to a thing has a good deal to do with one's ideas of its beauty, although it should be borne in mind that there are certain fundamental rules governing machine design that cannot be ignored with impunity, if a graceful appearance is to be attained.

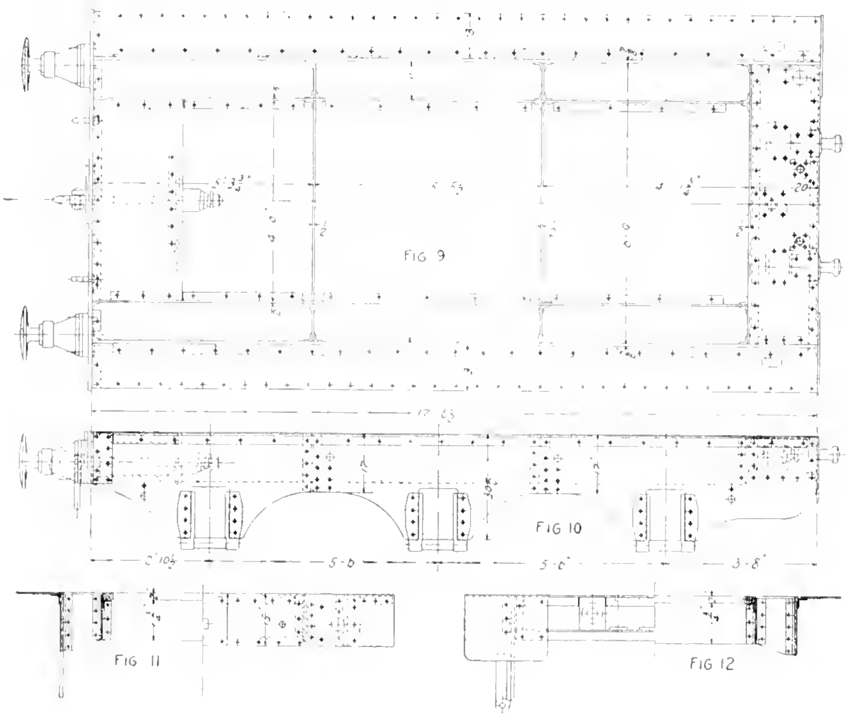
Inquiry has brought out the fact that in Australia, where the physical characteristics of the railroads approximate quite closely to the average of our own, there has been considerable trouble with the six-wheeled English-built tenders leaving the track, due to their want of flexibility, each of the three pairs of wheels being entirely separated from the others. A sag in the rail, or a low joint, causes the tender to pitch to an extent that not infrequently causes a derailment. The introduction of side equalizers between the middle and back springs has considerably reduced this trouble. It is tolerably evident, then, that if we are to use six-wheeled tenders on roads where the surfacing and lining-up are not maintained at a high standard, we must employ equalizers, just as we have found it necessary to do on our locomotives, and the question arises as to how the equalizers should be arranged.

Few of us, I suppose, would build a six-wheeled switching engine without side-equalizing the middle and back springs together, and cross-equalizing the front ones. It seems, therefore, plausible that a six-wheeled tender should have its spring gear similarly arranged, although it should be said that the tenders referred to above as running on a couple of Eastern roads, are giving good satisfaction without the cross equalizers, but it should also be said that the roadway in these cases is considerably above the average.

Fig. 15 shows a tender so equalized, recently built at the Rogers Locomotive Works, for a road in the Argentine Republic. It will be noticed that with this construction the weight is distributed in virtually the same way as it is with an ordinary eight-wheeled or double-truck tender, the fulcrums of the side equalizers representing the side bearings of the rear truck, and the fulcrum of the cross equalizer the center plate of the front truck. But the resemblance ends there, for while the trucks can swivel and adjust themselves to the curvature of the track, the axles of the three pairs of wheels must always remain parallel to each other, making a practically rigid wheel base of 10 or 11 feet. This, however, does not constitute a particularly valid objection.

The tender shown in Fig. 14 is side-equalized from end to end, but is without cross equalization. This construction cannot be recommended, and is only illustrated for the purpose of showing the framing, which will be considered later on. So much for the question of flexibility.

With regard to accessibility, it is hard to see from an inspection of Figs. 14 and 15 what there is to be claimed on that score. All the brake and tank valve work is hidden away very effectually, and to reach any point of it, a man must get in under the frames and between the wheels, which is usually unnecessary with the common American type of tender, if the parts are intelligently arranged.

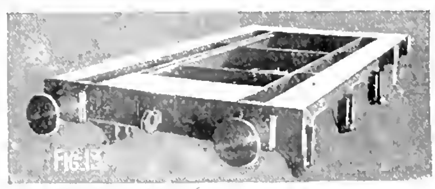


As to simplicity, the six-wheeler seems to have the best of it. Its running gear has fewer, although heavier, parts, which is an advantage, to the extent that there are less individual pieces to watch, and not quite so large a variety of stock to carry for repairs. The draw gear can also be arranged more scientifically than is always possible with an eight-wheeler, bringing the shocks and strains more nearly central with the greatest strength of the structure.

Opinion is pretty well divided in this country between wooden and iron or steel channel or angle frames, and there is much to be said in favor of both, so that, in comparing frames, both materials should be taken into consideration. Time was when there existed a decided prejudice in many minds against the metal construction, the idea being that it would prove extremely expensive to maintain, and in case of a wreck, would be so badly deformed that the cost of straightening out and putting in condition again would be prohibitively great.

These objections, however, have not been sustained by practical experience, and it is now generally conceded that the metal frame is no more costly to maintain than the wooden one, nor is it more susceptible to injury. An incident that happened not long ago, illustrates the ability of a well-designed and substantially built channel iron frame to stand rough handling, in a manner that is decidedly striking in every sense of the word. The frame had been put together on the fourth floor of a shop and was about to be lowered to the ground outside the building, when the tackle gave way and the frame dropped, landing entirely uninjured. This method of lowering was not forthwith adopted, however, in spite of its extreme simplicity.

Figs. 1 to 4 show a white oak tender frame of a design that has stood the test of hard service, carrying 4,000 gallons of water and 8 to 10 tons of coal with excellent results in a large number of instances, and



which may be fairly said to be representative. As will be seen from the drawings, the side sills are 13 inches deep by 5½ inches thick, the intermediates 5 x 8 inches, while the center is formed of one piece 12 x 6 inches. The transoms, which are heavily trussed by 1⅜-inch diameter iron rods, are 17 inches wide and 7 inches and sometimes 8 inches deep, with their ends secured by heavy cast-iron pockets, which also serve as the truss-rod bearings, instead of being tenoned into the side sills. The four corners of the frame are stiffened with angle castings,

and still further bound together by ¼-inch sheet steel plates on the outside. The longitudinal rods are 1⅜-inch diameter in the body, with upset ends 1½-inch diameter. The construction of the draw-heads is so clearly indicated as to need no special mention. This frame complete, with center plates, side bearings, etc., as shown, weighs about 7,500 pounds, and can be built for about $225—or 3 cents per pound.

FIG. 14

Figs. 5 to 8 show a 9-inch channel frame designed for service similar to that in which the oak frame just described is used. It consists of four longitudinal channels 9 inches deep by 2½-inch flange by ½-inch web, and two end pieces of the same section, the whole being heavily braced, diagonally and transversely. The transoms each consist of two 6 x ⅞-inch wrought iron bars, lipped over the edge of the side sills, and trussed by 4 x 1½-inch bars, as shown. Frames of this description have been in use for several years and have maintained their alignment and squareness to perfection, careful measurement and tramming showing absolutely no sagging or twisting.

When the loads to be carried are comparatively light, say 3,000 or less gallons of water and 4 or 5 tons of coal, 6-inch channels have been successfully employed instead of 9-inch, the general feature of construction otherwise remaining the same. A 9-inch frame, as shown, weighs about 6,500 pounds, and costs about $260—or 4 cents per pound.

Figs. 9 to 12 show a typical English plate frame, but it is, of course, almost superfluous to say that the use of similar frames in this country does not necessarily entail the adoption of spring buffers or the peculiar form of draw gear shown, and which are merely local features that have no bearing whatever on the advisability or otherwise of using the plate frame construction in this country, and will not be considered at all, beyond saying that their weight and cost are about the same as our style of draw gear and have been so taken. The side frames proper consist of two slabs of tank steel from ¾ inch to 1 inch thick and usually ⅞ inch. These slabs are obtained from the rolling mill in a rectangular shape and are then punched and slotted out to the form shown, great care being taken to have them as nearly as possible free from winding and buckling. Inside these slabs and about 11 inches from them there are supplementary frame plates ½ inch thick and 13 inches deep, but which are not so long as the main frames, stopping at a ½-inch crossplate 20 inches from the front end. This crossplate forms the back of what is virtually a box girder, forming the attachment for

the draw gear and at the same time operating to keep the frame square. The back bumper is formed of a 1-inch plate 15 inches deep.

The frame is strengthened crosswise by ½-inch plates, known as "stretchers," fastened to the slabs by angle irons, as shown. To keep the entire structure square and true, it is the European practice to bolt the bottom of the tank to the plates shown projecting beyond the ⅞-inch side slabs, which makes a very sound job. The journal boxes work in "horns" or pedestals formed by bolting heavy castings to the sides of rectangular recesses cut in the frames. Such a frame weighs about 8,000 pounds, and costs about $300, or 3¾ cents per pound. Fig. 13 shows one of these frames just erected, and Fig. 14 one in place on a completed tender. The running gear for this type of tender, including springs, equalizers, wheels, axles, etc., weighs and costs practically the same as a pair of trucks.

From this it appears that the claim of less weight per unit of capacity for the six-wheeled tender is not well founded, the balance being, indeed, in favor of the eight-wheeler. This is shown still more clearly by the table on next page, giving the capacities and weights of a number of recent six and eight-wheeled tenders. The comparatively poor showing of the European type is no doubt due to some extent to the employment of heavier material in the tanks and fittings, for it is noticeable that the Baldwin six-wheeler has considerably less dead weight per pound of load carried than any of the others of the same class, weighing only three-quarters of a pound per pound of maximum load carried, whereas the other nine average 1.096 pounds for each pound of load.

The eight-wheelers average .743 pound of dead weight per pound of maximum load, being about 25 per cent. lighter than the average of the six-wheelers. In other words, for a given capacity the American type weighs when empty only about three-quarters as much as the European.

It has been shown that the first cost of the six-wheeled frame is somewhat greater than the other, although it is quite possible that the cost of manufacture might be reduced by the introduction of special tools and appliances, if the demand justified it.

It has been practically impossible to obtain figures of any value for comparing the cost of maintaining the two types, due to the differences in operation in this country and abroad. The only really reliable way to get at the matter would be to keep an account of the repairs, etc., of examples of the two kinds when in similar service on the same road, otherwise figures are almost useless. The meagre and insufficient data

at hand indicate, though, that there is very little to choose between in this respect.

The whole matter may then be summarized as follows:

Accessibility—Favorable to the eight-wheeler.

Simplicity—Favorable to the six-wheeler.

Dead Weight per Unit of Capacity—Less in the case of the eight-wheeler.

First Cost—Less in the case of the eight-wheeler; the margin though is very small.

Cost of Maintenance—Uncertain; probably about equal for both types.

Name of Builder.	Type of Tender.	Capacity. Water in Gallons.	Capacity. Coal in Pounds.	Weight of Load (*i. e.*, Coal and Water) in Pounds.	Weight of Tender Empty, in Pounds.	Weight of Tender Empty per Pound of Load.
Great Eastern Ry. Co., England ...	6-wheel	3,170	10,000	36,400	36,400	1.00
Midland Ry. Co., England........	6-wheel	3,900	4,480	36,980	44,044	1.19
Northeastern Ry. Co., England	6-wheel	3,180	8,960	35,460	38,752	1.09
Glasgow & S. W. Ry. Co., Scotland.	6-wheel	2,520	6,720	27,720	32,760	1.18
Lancashire & Yorkshire Ry. Co., Eng.	6-wheel	2,160	6,720	24,720	31,360	1.27
Great Northern Ry. Co., England ..	6-wheel	3,000	11,200	36,200	38,588	1.06
Beyer, Peacock & Co., England....	6-wheel	2,880	6,720	30,720	30,936	1.00
Caledonian Ry. Co., Scotland.	6-wheel	3,325	10,000	37,698	37,342	0.99
Rogers Locomotive Works....... ..	6-wheel	3,000	10,000	35,000	38,200	1.09
Baldwin Locomotive Works.......	6-wheel	4,000	18,000	51,320	38,680	0.75
Rogers Locomotive Works.........	8-wheel	3,000	12,000	37,000	33,200	0.89
Rogers Locomotive Works.........	8-wheel	3,000	14,000	39,000	29,200	0.74
Rogers Locomotive Works..	8-wheel	3,850	16,000	48,070	31,500	0.65
Rogers Locomotive Works.........	8-wheel	4,000	16,000	49,320	31,200	0.63
Baldwin Locomotive Works.......	8-wheel	3,000	12,000	37,000	27,500	0.74
Baldwin Locomotive Works.... ..	8-wheel	3,500	9,000	38,155	34,000	0.89
Baldwin Locomotive Works.......	8-wheel	3,500	13,600	42,755	32,500	0.76
Baldwin Locomotive Works........	8-wheel	3,600	13,600	43,600	33,200	0.76
Baldwin Locomotive Works..... ..	8-wheel	4,000	12,000	45,320	33,800	0.74
Baldwin Locomotive Works........	8-wheel	4,500	16,000	53,480	34,000	0.63
Schenectady Locomotive Works...	8-wheel	3,800	16,000	47,650	31,000	0.65
Pittsburgh Locomotive Works	8-wheel	4,000	14,000	47,300	29,300	0.61
Pennsylvania R.R. Co....	8-wheel	3,600	15,000	45,000	27,850	0.61
Brooks Locomotive Works.	8-wheel	3,700	14,000	44,820	33,180	0.74

The conclusions to be drawn from the foregoing, which has been presented as impartially as possible, are that our wide use of the eight-wheeled tender is amply justified; that there is no particular objection to the use of properly equalized six-wheeled tenders on roads in good physical condition, but that their introduction is largely a question of personal preference, and that for general all-around service on the average road the eight-wheeler is the more suitable type, and is not in any danger of being supplanted.

The mechanical department of the Eastern Railway of France have been investigating the merits of the American standard form of car coupler with the view of adopting it. All the more intelligent engineers in Europe are coming to realize that the couplings used on freight cars are hopelessly defective and want reforming by a radical change of type. All cars have two buffers on each end, set almost above the rail, and the coupling for freight cars consists of several loose links like those used on some of our coal jimmies. A close coupler of the M. C. B. type would greatly increase the life of the cars.

The Difference Between Projected Area and Some Other Things.

BY JOHN ALEXANDER.

I've been keeping quiet lately, and some of the boys may have thought that the old man was gathered to his fathers; but don't you believe it for a minute. I've had a run of luck during the past year, however, and, say, darned if I know whether it's good luck or bad—you guess. In the first place, I told you more truth than poetry in one of my yarns, about a year ago, and didn't select my characters far enough away from home—got thirty days for that. Then I went fishing; got a big catch of rheumatics, and the doctor prescribed White Sulphur Springs—was thinking about mechanics and swearing at the rheumatics up there, mostly the latter, for two months. Then I was elected—no, chosen—well, lemme see; I guess "created" is the word—yes, "created" grandpa, and I have been working on this last job real steady.

Last week I got a letter from Fred that made me clean disgusted—I thought he knew more—I knew almost everything at twenty-seven.

It seems Fred has a new mogul that keeps her tank trucks hotter than her firebox, and the boy has been trying to figure out the reason of his troubles. That's just the best thing in the world to do if you figure right, but it does raise thunder when you figure wrong—and that's just what he has been doing.

After reading over my letter to him, and crossing a few t's and putting a dot or two over e's where I wan't altogether sure whether it should be an e or an i, it occurred to me that maybe LOCOMOTIVE ENGINEERING could be employed to carry a gob or two of that wisdom to a few young men who didn't have the advantage of a college education or have no wise old dad to refer to when clean stuck on a problem. It's mighty little trouble to explain a thing to a man who has run up against a snag and knows it, but when you have to explain *that there is a snag*, it's harder work—a good deal harder.

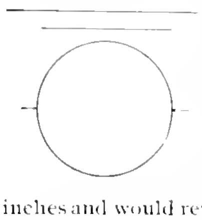
Now, that was the matter with Fred; he got up against a small case of "projected area," and he just laid his trouble to something else.

Projected area is a good deal like the poor they tell you about in the Bible—always with you—but not always recognized. In fact, projected area has traveled around in a good many shops under different aliases—generally, just plain "area," but sometimes as "superficial area" and once in a while a stranger thinks he recognizes in it "surface"—which is libel; raw, rank libel.

Fred wrote me that his tender journals were M. C. B. standards, $3\frac{3}{4} \times 7$ inches, and therefore the area of each journal was about $5\frac{7}{8}$ inches (equal to half the circumference of the axle) multiplied by 7 inches (the length of the journal), which was $41\frac{1}{8}$ square inches per axle, and the weight per square inch was so and so, which was light, etc.

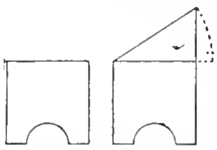
Now, this is dead wrong, and I'm disgusted that he didn't know it. He figured the *superficial area*, which—excuse refined Boston—cuts no ice in the case whatever.

The *projected area* of that journal is $3\frac{3}{4} \times 7$ inches, which is *only* $26\frac{1}{4}$ square inches—some difference.



I make you a little sketch to show you what I'm driving at. If a strip of tin was cut to bend over and fit that journal just half way around, it would be about $5\frac{3}{8} \times 7$ inches and would represent superficial area, as shown in the top line, while one cut to represent the projected area, as shown in second line, would only be $3\frac{3}{4} \times 7$ inches—and that's all the area you can pile load on.

If you bought a dry goods box 4 feet square for a dog house, it would do very well, perhaps, with a flat roof; but suppose you, or your dog, got stuck-up and wanted a "slantin'" roof, it would take more lumber for the roof, to say nothing about the gables and more side, and present more surface for paint; but it would cover the same size box only—the projected area would be the same in either case.



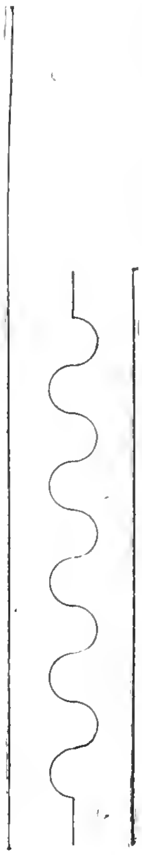
You can make a church roof so steep that Satan himself couldn't stand on it, and the shingles may run into more money than all the rest, but you can't increase the seating capacity this way, to save your soul.

I remember once, way back yonder before the war, of having a regular quarrel with my engineer (I was firing ice with

slivers in it for a machinist runner then) about the throttle stem blowing out. He maintained that, if the end was pointed, that the pressure in the boiler couldn't blow it out, and if it was left flat it would. I said it wouldn't make a bit of difference in the "projected area," and one would blow out as quick as the other, and that man froze me to the marrow by saying I was hell on theory but didn't know beans about practice—and he went to his grave believing that I was a born fool.

Why, it isn't more than a thousand years since I heard a way-up master mechanic tell his foreman boiler-maker to put in one-eighth inch larger stays in some new corrugated side sheets, remarking: "You know there is a sheet really eleven inches longer than the old one, with the same number of stays, and I don't want to take no chances."

I asked him if he thought there would be any more pressure exerted to blow off the crimped side sheet than the flat one that was there before.



"What was that sheet put in there for, John?" said he.

"To increase the heating surface, principally, I suppose," I answered.

"Increased it, didn't it?" he asked.

"Yes."

"Then, of course, it's got more surface for the steam to push on?"

"Not on your life!"

"Why, you dumb idjit, you just said it did."

"No, I didn't; I said it had more heating surface—not projected area."

"What's projecter-aree got to do with us? Martin, you put in them bigger stay-bolts; if it wussen't for me some of these fool engineers would blow themselves up!" And, say, he's vice-president now—and I'm running yet.

I wonder if that man had a sap kettle like Fig. 1, and bought another like Fig. 2, the deep one having double the capacity and surface, but the same diameter—projected area, in this case—that the yap would go and make a bigger hole in his brick arch to set it in.

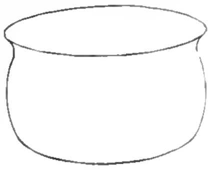


FIG. 1.

Why, only four or five years ago, a man somewhere out West *got a patent* on a slide valve for steam engines, with an Episcopal chapel roof on it for a top, and his claims were that it was so steep that the steam could not get the pressure on it that it could on a flat valve, and it therefore would *need no balancing*. He was also going to instruct the steam to push (impinge, I believe, he called it) on the sloping sides, and thus help move the valve and incidentally save the gear and the coal pile—but he forgot the anti-impinger for the off side of the valve. That valve will bear down just as hard with a hundred pounds on it as one as flat as a mother-in-law joke, and why? Because the *projected area* is the same in each case.

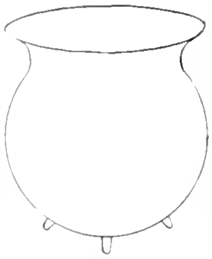
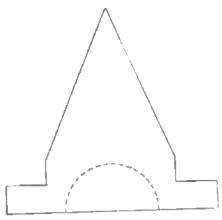


FIG. 2.

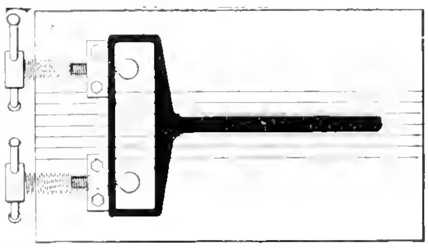
Boys, don't get *projected area* mixed up with mere *surface*; if you do, your calculations will come out wrong.

If you had a contract to whitewash Pike's Peak, you should go right ahead and compute the *surface* before you ordered the lime, and the projected area need not bother you for a moment; but if you took a contract to lower the whole mountain 10 feet, without spoiling the scenery, you would have to undermine it, and in figuring on that you would have to consider the *projected area*. If you figured on the superficial area here the other fellow would take the contract, because you would have to figure on using about four hundred years longer to do the job—and you'd need to buy Kansas to pile the rock in.



A Valve-Yoke Squaring Table.

Every mechanic who does repair work on locomotives knows that the ordinary valve yoke is an expensive thing to make. It is a very plain forging and the machine work on it is simple enough, but, in order to insure enough material to finish properly, they are usually forged a third heavier than they ought to be. A very little "out" in the opening throws the end of the stem a good way off.



At the Winona shops of the C. & N. W. they have a simple little kink in the blacksmith shop, the invention of Foreman Blacksmith John McNally and General Foreman J. F. Fleisher, that insures the stem being square with the yoke opening, and everything else, before it leaves the smith shop in the first place, and there is no reheating and bending after the yoke and stem have been centered and "laid out," nor monkeying with it in the machine shop.

The table is about 3 feet long by 2 wide, planed flat on top, with a number of lines running parallel with its length. About 8 inches from one end and 12 inches apart there stand up in the table two posts, round plugs with one side sharpened to a V, and between these and the end of the table are sliding blocks, moved by screws in the end of the table.

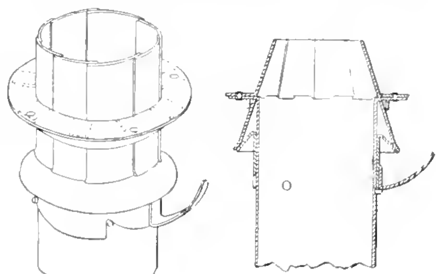
Now, if a valve-yoke forging is placed over these pins and the screws tightened up, the inside of the yoke opening, the side that must be finished, is brought at right angles to the lines on the table, and if the stem is not parallel with them it can be made to conform at once.

By using a surface gage on the table, the stem can be trued with the opening of the yoke, up and down, and, in fact, put in such shape while yet hot that it will go to the machine shop with only enough material to finish nicely and with a surety that it will not come back half a dozen times for straightening.

A New Variable Nozzle.

Roundhouse Foreman Jas. C. Heron, of the Great Northern, at Minneapolis, Minn., has recently patented a variable exhaust nozzle, as shown in our engraving.

The writer saw one of these in use, and must say that it seemed to work all right and would close, regardless of deposits of



dirt on the inside. The nozzle proper is composed of strips or staves of $\frac{1}{16}$-inch steel overlapping each other, as shown; they are hinged to a spring ring on top of the nozzle stand, and the opening is reduced by spreading the lower ends out, thus tipping the top ends toward a common center.

The spreading is done by a cone, as shown, which is raised by inclined notches on its base resting on pins in the nozzle stand.

General Master Mechanic Keegan, of the Grand Rapids & Indiana, has abandoned the striping of passenger coaches, to make his cars look like some of those of connecting lines—so he says; but we strongly suspect that the saving of $16 per car every time one is painted is a better reason and a good one. It's far better to save in places of this kind than to shut off the bread supply of some of the men.

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NO BACK NUMBERS BEYOND THE CURRENT YEAR

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Notice.

We are entirely out of copies of LOCOMOTIVE ENGINEERING for January, 1894. Can still supply a few complete copies for the other eleven months. Plenty of January, 1895, issue—all subscriptions can commence with the year, if so desired.

How the Steam Engine has been Improved.

For many years after the steam engine first came into use as a practical, prime motor, the leading aim of designers and improvers was to produce an engine which could be depended upon to do the work regularly without failure or delay. It took a long time to proportion parts so that they would endure the strains of service successfully. There were no testing machines to prove the strength of material, and estimates of the forces tending to disrupt the working parts of an engine were little better than intelligent guesses; so it is not surprising that break-downs and failures of engines were very common in early days. The writer has met in his youth old engineers in charge of spinning-mill machinery, who maintained that the old water wheel was a motor much superior to the steam engine, because it rarely broke down. To a manufacturing concern, an engine that was not given to breaking down was of much greater value than one which was light on coal and was given to causing stoppages for repairs. The stoppage of a mill a day or two for repairs would cause much greater loss than saving in coal by superior use of steam would compensate for in years. These considerations led the pioneer engineers to make their proportions on the principle—make it strong enough to begin with, and then add a half more strength for emergencies. By degrees, this philosophy brought forth an engine that did not break down.

When the question of strength was settled, that of economy in the use of fuel came up. It has remained a living issue ever since, and is likely to provide work for the experimenter and the inventor for many years to come. It is the most important problem that science and ingenuity have ever been offered for solution.

There have been great economies effected since Newcomen first applied steam to a piston, but there appears still to be a fair margin of waste to work upon, when it is understood that the most economical form of steam engine does not make use of more than one-tenth of the energy of the fuel employed for raising steam. Before going into particulars, it may be as well to explain to our younger and non-scientific readers some units which engineers and scientists use in working out steam engine problems.

In mechanics the word "energy" means a power to do work. Heat is known to be a form of energy which can be made to perform mechanical work, or which can be generated by mechanical work. When you strike a rod on an anvil with a drop hammer, it is heated, and the rise of temperature is equivalent to the mechanical energy of the blow struck. If it were possible to utilize the heat imparted, it would be sufficient to raise the hammer to the point from which it started to strike the blow. The heat generated in cutting metal on a machine tool is the conversion of mechanical energy into heat, and a perversion of the same phenomenon is a dry car journal drawing energy from the locomotive to turn it red hot. A rather familiar example of heat energy being converted into work, and then back into heat, is furnished by a railroad train. The coal burned in the firebox of the locomotive generates steam, which puts the train in motion. When a stop has to be made, the brakes are applied, and the work put into the moving train is converted into heat in the brake shoes.

The amount of heat generated or used is measured by the heat unit, or thermal unit, as some people call it, which is the quantity required to raise the temperature of one pound of water, at its greatest density, one degree Fahrenheit. A foot pound of work is one pound raised one foot high. One heat unit is equal to 772 foot pounds, or, in other words, it represents energy sufficient to raise 772 pounds one foot. This 772 foot pounds is called the mechanical equivalent of heat. A mechanical horse-power is 33,000 pounds raised one foot in one minute, and therefore a horse-power per hour is 1,980,000 foot pounds.

Pioneer steam engine inventors and improvers heard very little about the possible amount of work contained in a pound of good coal, but scientists have made latter-day engineers very familiar with the figures. Science apostles are more rampant to-day than they were in the beginning of the century, and they are not afraid to tell wholesome truths. They have been preaching so loud, that few intelligent engineers have failed to hear, that when one pound of coal undergoes the chemical change known as burning, or combustion, heat energy is generated to the extent of 14,500 heat units. As each heat unit represents 772 foot pounds, we have $14,500 \times 772 = 11,194,000$ foot pounds, or dividing this by $1,980,000 = 5.65$ horse-power from the combustion of one pound of coal. As it is a first-class engine which makes one horse-power on the consumption of 1.75 pounds of coal per hour, an engine of this kind, to do the work of 11,194,000 foot pounds, would use $5.65 \times 1.75 = 9.88$ pounds of coal. At this rate about 10 per cent of the heat of combustion is utilized in the cylinders. This makes it clear that the problem of making the steam engine do more work in proportion to the fuel energy used up is one worthy of the brightest mental steel.

A steam engine which would utilize the whole of the potential energy in the fuel would be a perfect machine, but the world will have to be contented with something a good deal short of perfection, yet there are good prospects of further important improvements being effected on a practical basis. To convert the whole of the fuel energy into mechanical work would require an engine capable of generating steam without loss by hot gases of combustion passing into the atmosphere. Then the steam generated would need to reach the cylinder without encountering any heat losses, and there expand, while doing exclusively useful work, until the absolute zero of heat motion was reached. The practical law asserts that under existing conditions it is impossible to convert the whole of any given quantity of heat into work, and that the ideally perfect engine can only convert a fraction of the heat energy into mechanical work.

Scientific investigations have done remarkably little in the development and improvement of the steam engine, but they supply useful information concerning the limitations and possibilities of future improvements. The engineers who developed the steam engine from a crude cylinder, fitted only for driving a pump, and consuming between 30 and 40 pounds of coal per horse-power of work, to the quadruple-expansion engine that drives our ocean steamers on a coal consumption of 1¾ pounds of coal per horse-power per hour, have followed a highly practical lead. They have taken as an example the merchant, who tells that the way to make money is to buy cheap and sell dear. The engineers have varied this principle of trade into the maxim—admit steam at the highest possible temperature and exhaust it at the lowest. They have met with numerous practical difficulties in following this policy, but perseverance, patience and intelligent effort have led the way over most of the obstacles to reduced fuel consumption.

The improvements have kept pace with increase of steam pressure, when it was accompanied by practical means for admit-

ting at high and exhausting at low pressure. Newcomen used steam barely the pressure of the atmosphere, and used from 30 to 40 pounds of coal per horse-power. His engine was improved by Smeaton till it could be operated by steam of 4 or 5 pounds pressure, and the coal consumption was reduced to about 20 pounds. Watt made more radical improvements, and raised the steam pressure to 10 pounds, and he obtained a horse-power on 8.8 pounds of coal per horse-power. At the same period, Oliver Evans, with a much simpler, cruder and less costly engine, but with steam pressure of four or five atmospheres, brought the consumption of coal down to 6.7 pounds per horse-power. Woolf's compound engine still further reduced the coal consumption to 4.5 pounds of coal per horse-power, but he employed about 80 pounds steam pressure.

The Woolf engine, with all its economy of steam, did not meet with popular favor because it was difficult to keep in running order, and at the beginning of this century boiler making was not equal to controlling of steam much above 40 pounds to the square inch. On this account, improvement of the steam engine remained almost stationary for fifty years, till John Elder, of Glasgow, Scotland, effected improvements on the compound engine which reduced the coal consumption to about $2\frac{1}{2}$ pounds per horse-power. In Elder's successes the surface condenser was an important element, because it enabled steam users to use the same water over and over again, which keeps the boilers free from scale.

The improvements on the locomotive as an engine for economically converting the energy of coal into work have not kept pace with the progress made by stationary and marine engines. The early types of locomotives that were operated with very little valve lap were very extravagant in the use of steam, but that practice existed for only a short period in the history of this kind of engine. Ever since the link motion was introduced the practice has been followed of proportioning the valves, so that steam could be cut off at from one-fourth to one-third of the stroke, when the work could be done with that volume of steam. Since that time there has been no improvement effected to employ the steam more economically in the cylinders, except in the comparatively few compound locomotives put into service. The modern locomotive performs a horse-power of work much more economically than the engine of thirty years ago, but the improvement is not in the steam distribution. It is due, principally, to a better proportion of boiler to cylinders, to higher steam pressure and to more liberal heating surface. There are few locomotives that develop a horse-power on less than 3 pounds of coal, and the majority of our engines use over 5 pounds of coal per horse-power, and not a few go considerably higher than that. The man who is inspired with a mission to improve the steam engine may use this statement as a hint of where a good beginning might be made.

Where Engineers Hire Their Own Firemen.

There have recently been some agreements entered into between the management and the engineers of the Canadian Pacific, and the other road controlled by it, that are new and appear to be greatly to the advantage of the men if rightly used.

On the Canadian Pacific proper, the officials have agreed to promote all their future foremen of roundhouses, traveling engineers and master mechanics from the ranks of the engineers.

Now, the best thing the engineers can do is to enter into a combination to make that rule productive of good results—see to it that the best of them get the positions, and then help the men promoted to make their work show—with results. There is altogether too much opposition to minor officials, on no good ground, by enginemen. When a man is taken off an engine to fill a better position there is too much tendency of the older men to say, "Why, he fired for me ten years ago—he don't know nothing!" Among the younger men there is as often a spirit of "getting ahead" of the new official and treating his instructions more in the nature of advice than orders.

If the men work together on the Canadian Pacific, the new plan can be made a success; if they fail to hold up the hands of their brothers raised to power over them, it will be a failure, not long in force, and the "line of promotion" will end at the throttle. But to our subject.

The Minneapolis, St. Paul & Sault Ste. Marie have entered into a new agreement with their engineers that virtually places the manning of the motive power in their hands.

In the first place, they concede to the engineers the right to hire, discipline or dismiss their own firemen.

They only require that the fireman stand an examination for color blindness and education, be in good health, furnish a certificate of good character and be not over thirty-five years of age. Next, they agree to hire no engineer, except he be recommended by three full-paid engineers in the service.

Then they agree to promote no fireman, except he be nominated by the engineer he is firing for and seconded by two other full-pay engineers. Such a nomination makes a fireman eligible for examination on time card and rules by the superintendent, and on machinery by the mechanical superintendent. At these examinations the men who recommend a man for promotion may be present or choose other engineers to attend.

The standard pay is fixed as follows:

CLASS OF ENGINES.	CENTS PER MILE. First Year Rate.	Full Rate.
Eight-wheel	.0484	.0579
Mogul	.0514	.0609
Consolidation	.0533	.0628
Consolidation on Way Freights		.0702
Switching	.0425	.0450

But there is a long list of special agreements for certain runs on every division—most of them providing for full pay for short runs.

Each month the engineer is sent a check for the amount of his wages (including the fireman's), and must return a special receipt from the fireman showing that he has been paid in full for his month's work, and how much.

The rules further provide that the engineer will make such rules and regulations for the government of his fireman as he himself may deem proper.

No officer of the company will undertake to exact of firemen any specific duty.

An engineer will be at liberty to hire a fireman that may have been discharged by another engineer, except the discharge be based on sufficient reasons to debar the man from further employment.

The standard of excellence for engineers is to be based on the performance sheet. Should the performance sheet show undue expenditures on account of any engine, the engineer's attention will be called to it, and it is believed that he will apply the remedy.

All firemen were notified on August 27th last that their services were no further required by the company, and they were paid off.

The following restrictions were placed on the hiring of firemen:

To avoid legal complications, no engineer will hire a fireman who bears the same surname as himself. He will not hire a man who has made himself obnoxious to the company in any way.

Inasmuch as the names of firemen do not appear on the company's roll, engineers desiring meal tickets for their firemen are held responsible for their payment, but as the entire compensation for themselves and their firemen is sent to them, they can easily protect themselves.

When, by reason of slack business, an engineer may desire to take service as a fireman, the engineer having the junior fireman will be asked to suspend his fireman for one month, to give an engineer an opportunity of firing. He has the right to decline to do so, if he choose, without prejudice. In case of declination, the engineer having the next junior fireman will then be asked to displace his fireman for one month, to allow an engineer an opportunity to fire. Should he decline, the engineer having the next junior fireman will then be asked to displace his fireman for one month, to allow an engineer an opportunity to fire. Should he decline, the company will then decline to make any further effort to furnish the engineer employment as a fireman, and whether he may find such employment or not will not affect his standing as an engineer.

By registering their addresses, firemen will be called, and engineers will not be held responsible for delays to trains caused by the failure of a fireman to answer his call. They will, however, be expected to secure substitute firemen with as little delay as possible.

All cases of delay or switching service, of calls, without making mileage, are provided and paid for.

The company will refuse to retire junior engineers when the average mileage equals 2,400 miles in thirty days.

The company will issue transportation to engineers of other roads if asked for by men on their own road.

Taking it altogether, it's a strong agreement, and appears to concede much to the men.

The principal new feature is the employment of no firemen by the company, and the absolute control of the firemen force by the engineers.

No man can be promoted without the consent and effort of his engineer and two others.

A fireman has no superior officer except his engineer; he may be discharged without an appeal to any other authority, and has only one hope of relief—to be hired by another engineer.

There is a widespread feeling among engineers that there have been too many promotions in the past, and that too many engineers are roaming up and down the land seeking employment, and they are right. While this arrangement lasts, it is not likely that the "Soo" will swell this list. This will be a good thing for the engineers out of employment, but may not be altogether fair for the men at the scoop—it would be, however, were the rule universal.

It places such matters as coal economy, clean engines, sober firemen and congenial companionship entirely in the hands of the engineers, and will make the responsibility easy to place.

We imagine this plan will be successful or a failure according to the temperament of the individual on each engine. The writer has known good engineers whom a saint could not suit as a fireman, and thinks, under this plan, they would be busy hunting firemen a good deal of the time.

As for the engineers, the plan should be a good one for them if it is taken care of and intelligently and honestly administered.

The firemen will not be quite so independent—will, in all human probability, fire longer before promotion, and take more interest in their engines than heretofore, and will send no committees to headquarters about pay.

The company simplify matters some, prevent one set of grievance committees, and put out of their hands the selection and education of their future engineers, which is a serious matter. The new plan may help this or make it worse—nothing but a trial will tell.

So far, things seem to be working smoothly. The engineers got together and agreed that they would pay the old rate of wages, and are doing so.

What would happen in case of a strike is hard to tell. If the engineers struck, it is not hard to guess; but what if the firemen struck?

Each engineer is interested in his own engine and her work, and on her performance he is judged. It seems as if it ought to be a help to have absolute control of everything on the engine. The friends of the system say it's a great step in advance; the enemies, that it's a monumental mistake. It's original, anyway, and may have many virtues we know not of; it may be better than it looks.

Much—yes, everything—depends on how it is done. Let us hope that the engineers of the "Soo" are manly, upright and just enough to give the plan a fair, impartial trial, and let it win or fail on its merits.

Mr. Fred. J. Miller has been made editor of the *American Machinist*, with which paper he has been connected as associate editor for the past seven years. Mr. Miller is one of the best examples of what a mechanic can do with himself if he tries. Starting as an apprentice in an obscure shop, he advanced himself from one position to another by study and work; he made no great moves, but never stopped going up—took all the degrees, as it were—until to-day, at the age of thirty-seven, he finds himself editor of the first paper in America representing his trade. His advancement has been due solely to his own work and efforts, and, as he is just as painstaking now as he was at the start, it is fair to assume that he has not yet reached the top—we don't know where he will go next; he has a larger audience now than he could well hope for in any college, but go he will. Fred. J. Miller's success comes from making a specialty of one thing; he is one of the best-posted men in America on machine tools, and does not claim to be or try to be a mechanical dictionary on every thing with wheels in it.

A correspondent in New South Wales writes us that they are undergoing examination for color blindness, and that a good many men are being found short-sighted or color blind, and the runners are reduced to ranks, as laborers or cleaners—from 11 to 13 shillings per day to 6 shillings. He thinks this hard lines, and so it is, but it's a little improvement over the American plan of discharge. It's a mighty poor management that can't find a shop place, inspector or roundhouse job for an engineer who has done his duty for years and is suddenly discovered to be defective in color sight. He is certainly entitled to more than laborer's pay, if such a job is to be had.

The *Journal* of the Brotherhood of Locomotive Engineers came out the 1st of January with a neat, new cover and very much improved interior. Brother C. H. Salmons is making a better journal than the Brotherhood ever before had, and one that they may well feel proud of.

BOOK REVIEWS.

PROCEEDINGS OF THE INTERNATIONAL ELECTRICAL CONGRESS. Published by the American Institute of Electrical Engineers, 26 Cortlandt street, New York. Price, $3.

This is a large illustrated work, containing the papers submitted to the congress which was held in Chicago in August, 1893. The book is one for advanced electricians, and we should think none of them would wish to be without it. It is a fine work typographically, but we confess entire inability to understand its contents.

RAILROAD MANUAL OF INSTRUCTION. For brakemen, conductors, firemen and engineers. Especially adapted to the new beginner. By Rollo I. Wood and William K. Hollis, Beardstown, Ill. Published by the authors. Price, 50 cents.

This is a neat little book, with a few brief chapters to beginners as firemen and brakemen. The engineers' chapters are in the form of questions and answers, and seem to be all right, so far as they go. The last half of the book is composed of the standard rules. It is worth the price, especially for new beginners, and will help older hands as well.

MODEL ENGINE CONSTRUCTION. With practical instructions to artificers and amateurs. By J. Alexander. Published by Macmillan & Co., 66 Fifth avenue, New York. Price, $3.00.

This is an English work and seems to be intended for those who desire to make small model or toy engines. It has complete directions for making almost every kind of engine, but not models as we understand them—rather, toys. All the locomotive examples are English engines. It would be useful to those contemplating this kind of work.

THE REPAIR AND MAINTENANCE OF MACHINERY. By Thomas Walter Barber, C. E., M. E. Spon & Chamberlain, New York. Price, $3.50.

This book has been published to provide useful practical notes and memoranda for engineers and machinery users. The purpose of the author was to make it as general as possible, dealing more with the defects of machinery in general than with those of any particular class. The book relates more to the faults and defects found in machinery than to the merits and excellences that attract small attention from men engaged in doing repairs.

There is a rather exhaustive section devoted to steam boilers which gives valuable information about the construction of the leading forms of boilers, and particulars of how the repairs are done. Many suggestions and facts are given which will be useful to men not boiler makers who are called upon to do emergency repairs. Throughout the book the information given is of a kind more likely to be useful to men strange to the work than to the workmen who are accustomed to do repairs regularly. Opinions are expressed very positively concerning the merits of devices, forms and material, and they appear generally to be sound and calculated to influence in the right direction. The author, however, appears to wade beyond his depth at times and makes recommendations which are not sound, as when he says that all throttle valves of locomotives should be placed outside the boiler. He also favors the use of flue furnaces instead of fireboxes for locomotives.

The various forms of prime movers and motors are described at great length and profusely illustrated. This does not, however, include electric motors, which are

entirely omitted. Nearly all other known forms are, however, described, and the book will be a useful reference for those who meet with maladies which they cannot understand in almost any form of prime mover or motor.

Among miscellaneous subjects treated are transmission of power, hoisting machinery, transport, machine and hand tools, wood machinery, pipe work, presses, printing, repairing shops and tools, and laundries. The subjects are all treated from an English standpoint, and it does not always coincide with American practice.

REPORT OF THE SECOND ANNUAL MEETING OF THE TRAVELING ENGINEERS' ASSOCIATION. Edited by W. O. Thompson, Secretary, Elkhart, Ind.

This is a volume of 208 pages of the standard size, and contains on every page valuable information for those interested in the operating of locomotives. The reports read and the addresses delivered at the convention are full of facts that will increase the knowledge of railroad men generally if they are read and digested. There is a minimum of vague theorizing, and a maximum of practical information in the reports and in the discussions. The reports read were on: First—The true and false economy of caring for, and the safe handling of, the air-brake under all conditions. When examining a fireman for promotion, how much knowledge of the air brake is it necessary for him to have to be considered fully competent to take a train on the road? This report elicited a long discussion, in which many valuable points were brought out. Second—What are the means of saving coal and increasing or holding the mileage per ton at a desirable figure? This report consisted of forty questions and answers. They covered comprehensively the influences at work on the saving or wasting of fuel. The report was supplemented by a good discussion, in which the speakers demonstrated that they were very well informed on fuel economy. Third was on—What relation does a clean engine bear to the economical use of supplies? The testimony of this report was that clean engines are not the rule. The discussion showed that the traveling engineers considered that it was economical to keep locomotives clean, but they have difficulty in convincing those above them of this fact. The fourth report was on a uniform form of examination of firemen for promotion, and new men for employment. This report consisted principally of the questions which were sent out with our January number in pamphlet form. The sixth report was rightly a part of the second, for it was on the best means of saving coal and increasing the mileage per ton. Six recommendations were made—all of a highly practical character. The seventh report was on—How can we improve the service when engines are double crewed? This report and the discussion thereon went to show that the essentials for successful pooling are: Co-operation of the men; have as little work as possible done on engines by enginemen; hold the crew to strict account for tools and supplies, and have competent inspectors and men in the shop to do the rest. The last report was on the testing of coal in actual service. This related to the methods of carrying out road tests.

Besides these reports, there was an excellent address delivered by the president, and another by President Jeffery, of the D. & R. G. There were also valuable papers by Mr. George Royal on the injector and on sight-feed lubricators. Mr. C. E. Stretton contributed a paper on spark arresters.

PERSONAL.

Mr. James F. Pendergast has been appointed general foreman of the Benwood, W. Va., shops of the Baltimore & Ohio.

Mr. C. W. Bowie has been appointed train dispatcher of the Monongahela River Railroad, with headquarters at Monongah, W. Va.

Mr. W. Dale Harris, chief engineer of the Ottawa & Gatineau Valley of Canada, has also been appointed managing director of that road.

Mr. A. Dolbeer, the well-known master mechanic, has been appointed superintendent of the Boies Car Wheel Works, Scranton, Pa.

Mr. Joseph M. Rogan, the well-known railroad supply man, has become agent in Chicago for the Carpenter Steel Co., of Reading Pa.

Mr. A. J. Gibbons, engineer of maintenance of way, of the Vandalia Line, at Terre Haute, Ind., has been appointed chief engineer.

Mr. H. F. Bull has been appointed general car inspector of the Lake Shore & Michigan Southern, in place of Mr. F. H. Soule, resigned.

Mr. D. I. Jones has been appointed chief train dispatcher of the Eastern division of the Chicago & Erie, with headquarters at Huntington, Ind.

Mr. J. N. Ross has been appointed superintendent of the Sixth division of the Southern Railway, with headquarters at Birmingham, Ala.

Mr. George B. Beale has been appointed assistant engineer of the Middle division of the Pennsylvania Railroad, with headquarters at Renovo, Pa.

Mr. F. E. Voight, for the last ten years master mechanic of the Cincinnati, Lebanon & Northern, has resigned. He is open to accept a position.

Mr. W. W. Pitts, an engineer on the Mexican National, has been appointed general foreman at Tolnca, Mex., in place of Mr. H. Stone, resigned.

Mr. M. D. Murray has been appointed superintendent of the Allegheny & Kinzua, with headquarters at Bradford, Pa., to succeed Mr. C. V. Merrick.

Mr. W. E. Richards has resigned as chief train dispatcher of the Northern division of Chicago, St. Paul, Minneapolis & Omaha, at Spooner, Wis.

Mr. B. D. Alexander has been appointed chief train dispatcher and car accountant of the Indiana & Illinois Southern, with headquarters at Sullivan, Ind.

Mr. E. T. Clarage has associated himself with Sanderson Brothers Steel Co. as general manager of their Chicago branch, with office at 11 South Jefferson street.

Mr. Thomas Adams, son of Mr. F. D. Adams, of the Boston & Albany, has accepted the position of agent for the Glidden & Joy Varnish Co, Cleveland, O.

Mr. Stephen Fitzgerald, of Memphis Tenn., has been appointed assistant to President Fordyce, of the St. Louis Southwestern, with headquarters at St. Louis, Mo.

Mr. F. N. Risteen has been appointed master mechanic of the Dakota & Missouri divisions of the Northern Pacific, with headquarters at Fargo, vice J. E. Phelan, resigned.

Mr. F. L. Corwin, superintendent of the Cascade division of the Great Northern, has been appointed superintendent of the Breckenridge division, with headquarters at Willmar, Minn.

Mr. William E. Chamberlain has been appointed assistant superintendent of the New York division of the New York, New Haven & Hartford, with headquarters at Harlem River, N. Y.

Mr. C. L. Rossiter, assistant superintendent of the Western division of the New York Central, is confined to his bed with a broken leg, caused by slipping on the ice on his door steps.

Mr. J. P. McCuen, master mechanic of the Alabama Great Southern, at Birmingham, Ala., has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific, at Ludlow, Ky.

Mr. F. Slater, general foreman of the Milwaukee, Lake Shore & Western, at Kaukauna, Wis., has been appointed general foreman of the West Chicago shops of the Chicago and Northwestern.

Mr. B. Reiley has resigned as master mechanic of the Des Moines Union to accept the position of general master mechanic of the Iowa Central, with headquarters at Marshalltown, Iowa.

Mr. C. Skinner, who has been general foreman of the C., N. O. & T. P. shops, at Ludlow, Ky., has been appointed master mechanic of the Alabama Great Southern, with headquarters at Birmingham, Ala.

Mr. F. B. Harriman, superintendent of the Freeport division of the Illinois Central, has been transferred from Freeport, Ill., to Dubuque, Iowa, and will have his jurisdiction extended to Fort Dodge, Iowa.

Mr. J. V. Goode, heretofore division superintendent of the Fort Worth & Denver City, at Wichita Falls, Tex., has been appointed general superintendent of that road, with headquarters at Fort Worth, Tex.

Mr. Chester W. Bliss, who has been connected with the Boston & Albany for a number of years, has been appointed assistant general superintendent of that road, with headquarters at Springfield, Mass.

Mr. J. H. Klein, chief train dispatcher of the Eastern division of the Chicago & Erie, has been appointed trainmaster of that division, with headquarters at Huntington, Ind., in place of O. F. Gross, deceased.

Mr. Thomas Riley, formerly general superintendent of the St. Louis, Kansas

City & Colorado, has been appointed division superintendent of the Monterey & Mexican Gulf, with headquarters at Monterey, Mex.

Mr. T. W. Kennedy, chief train dispatcher of the Eastern division of the Chicago, St. Paul, Minneapolis & Omaha, at St. Paul, has been transferred to Spooner, Wis., as chief train dispatcher of the Northern division.

Mr. W. H. Whitaker, formerly master mechanic of the Minneapolis & St. Louis, has been appointed master mechanic of the Des Moines Union Railway, with headquarters at Des Moines, Iowa, in place of Mr. B. Reiley.

Mr. James P. Bradfield, general superintendent of the New York, Ontario & Western, has been appointed superintendent of the Western division of the New York Central & Hudson River, with headquarters at Buffalo, N. Y.

Mr. W. S. Clarkson, for twelve years past roundhouse foreman of the Northern Pacific, at Glendive, Mont., has been appointed master mechanic of the Rocky Mountain division of that road, with headquarters at Missoula, Mont.

Mr. V. A. Riton has been appointed superintendent of the Cascade division of the Great Northern, with headquarters at Leavenworth, Wash. Mr. Riton has been roadmaster of the Chicago, Milwaukee & St. Paul, at Chicago, since 1886.

Mr. R. C. Wright, an old-time expert—well known through his work in building the models and arranging the exhibit of the B. & O. road at Chicago—has opened an office at 906 Walnut street, Philadelphia, as an expert and patent attorney.

Mr. J. A. Larnerd has been appointed assistant superintendent of the Silver Springs, Ocala & Gulf, and that portion of the Savannah, Florida & Western, South Florida division, between Lakeland and Santa Fé Junction, Fla., with headquarters at Ocala, Fla.

Mr. S. A. Spencer has been appointed trainmaster of the Eastern district, Fairmont district, Somerset & Cambria, Confluence & Oakland, Berlin & Salisbury railroads, and O. & B. short line, all operated by the Baltimore & Ohio, with headquarters at Connellsville, Pa.

Mr. J. F. Graham has been appointed master mechanic of the Oregon Railway & Navigation Company, with headquarters at Portland, Ore., to succeed Mr. E. B. Gibbs, resigned. Mr. Graham has heretofore been division foreman at Le Grande, Ore.

Mr. A. B. Burtis has been appointed to take charge of the railroad department of Lowe Brothers' Co., Dayton, Ohio, manufacturers of paint. Mr. Burtis was for years manager of the railroad department of Shewin, Williams & Co., and is one of the most popular men in the railroad supply business.

Mr. S. A. Souther, heretofore general foreman of the Benwood, W. Va., shops, has been appointed master mechanic of the Parkersburg & Wheeling division of the Baltimore & Ohio, with headquarters at Grafton, W. Va., in place of Mr. George C. Smith, who has been transferred to Keyser, W. Va.

Mr. Edward Canfield, chief engineer of the New York, Ontario & Western, has been promoted as general superintendent. Mr. Canfield has had a great deal of experience in the engineering department of railroads, and was for several years superintendent of the Middle division of the Ontario & Western.

Mr. A. Harrity, M. M. of the N. P., at Missoula, Mont., resigned on January 1st to take a better position on the Butte, Anaconda & Pacific. The employés of the machinery department presented him with a purse of $250 on his leaving. Mr. Wm. Clarkson, general foreman at Glendive, Mont., has been appointed to fill the vacancy.

President Hoffman, of the Seaboard Air Line, has officially announced Mr. E. St. John's election as vice-president, in an official circular, which reads as follows: "Mr. Everitte St. John, having been elected vice-president of the railroads comprising the Seaboard Air Line, will assume the duties pertaining thereto on January 1, 1895, with headquarters at Portsmouth, Va. All officers and department chiefs will report to Mr. St. John, and be guided by his instructions."

The numerous friends of Mr. F. D. Adams, superintendent of the car department of the Boston & Albany, will be grieved to learn that his wife died on January 18th. There were few ladies who attended the annual conventions that were better known than Mrs. Adams, and her quiet, kindly ways made warm friends wherever she went. The hearts of men and women, far and wide, will go out in sympathy with Mr. Adams in the loss which he has sustained. Mr. and Mrs. Adams celebrated their golden wedding last August.

Mr. A. A. Allen, general superintendent of the Missouri, Kansas & Texas, has been appointed assistant general manager of that road, and will assume the duties of general manager during the absence of General Manager Purdy in Europe. The position of general superintendent having been merged with that of the assistant general manager, all officials and employés heretofore reporting to the general superintendent will report to the assistant general manager. Mr. Allen's headquarters, as general superintendent, have been at Parsons, Tex., while the headquarters of the general manager are at St. Louis, Mo.

Mr. E. E. Davis has been appointed assistant superintendent of motive power of the Philadelphia & Reading, with headquarters at Reading, Pa. Mr. Davis was trained on the Boston & Maine, and was for several years master mechanic at Boston, in charge of the principal repair shops. There he gained more than local reputation for his clean, orderly shops, and for the labor-saving methods which he employed in the production of finished repairing material. This reputation brought him an offer of the position of superintendent of the Boies Steel Wheel Works, at Scranton, Pa., which he has filled for about two years, and leaves to go the Reading.

Mr. J. E. Phelan, who has contributed many articles to our columns, has resigned the position of master mechanic of the Northern Pacific to accept that of secretary to the Board of Railroad Commissioners of North Dakota. Mr. Phelan began railroad work as a fireman on the Lake Shore & Michigan Southern, and ten years ago was an engineer on the Northern Pacific. From that he was raised to be road foreman of engines and subsequently promoted to be master mechanic and assistant superintendent of two divisions for three years. He possesses much literary ability, which, together with his knowledge of railroad operating, will make him a valuable mentor to the Railroad Commissioners.

Mr. S. R. Callaway has been elected president of the New York, Chicago & St. Louis, succeeding Mr. D. W. Caldwell, elected president of the Lake Shore. Mr. Callaway is a Canadian by birth, and received an excellent training in the commercial department of railroad work on the Grand Trunk. Then he was made chief clerk to the superintendent of the Great Western, from which he rose by regular steps to be general manager of the Chicago & Grand Trunk. For three years he was vice-president and general manager of the Union Pacific, where he was highly popular. He has lately been receiver of the Toledo, St. Louis & Kansas City. Mr. Callaway has been noted among railroad officials for the warm interest he takes in the personal welfare of all the men under him.

We have to acknowledge having a pleasant visit last month from Mr. John G. Hartigan, assistant general superintendent of the Illinois Central. Mr. Hartigan was born in Vermont, forty-eight years ago, and from his early boyhood decided to become a railroad man. As a preliminary he learned telegraphy by the aid of a good-natured station agent, and, when he was sufficiently expert, went West to seek his fortune. He obtained a job on the Chicago & Alton, and rose on that road to be successively station agent, train dispatcher and chief train dispatcher, Mr. McMullen being then chief train dispatcher at Bloomington. Mr. Van Horn was a superintendent on the road, and made up his mind that young Hartigan had the material in him from which good railroaders are made up. When Mr. Van Horn went to the C., M. & St. Paul he took Mr. H. along as train dispatcher.

He has gone gradually forward to his present position.

Mr. E. M. Herr has been appointed assistant superintendent of motive power of the Chicago & Northwestern, with headquarters in Chicago. Mr. Herr began railroad work as a telegraph operator, but not seeing a satisfactory future through that line of progress, he went to an engineering school and graduated as a mechanical engineer. He was for some time in the test department of the C., B. & Q., and was then promoted to be superintendent of telegraphs. Afterwards he was appointed division superintendent, and left that to be master mechanic on the Chicago, Milwaukee & St. Paul. From that he was appointed superintendent of the Grant Locomotive Works. Lately he has been superintendent of the Gibbs Electrical Works at Milwaukee. Mr. Herr has contributed several valuable engineering papers to the Western Railway Club, and one of them started the discussions about counterbalance of locomotive driving wheels, which we have been hearing so much about lately.

Mr. D. W. Caldwell has resigned as president of the New York, Chicago & St. Louis to give his entire attention to the Lake Shore & Michigan Southern.

Truly "brevity is the soul of wit." A neat, very brief and terse circular on "The Cheapest Packing" has just been issued by C. A. Daniel, manufacturer of the P. P. P. brand of Diagonal rod packing, 323 Market street, Philadelphia, Pa., which puts the case in a nut-shell, so to speak, "without being tiresome." Mr. Daniel will be glad to mail one to any reader of LOCOMOTIVE ENGINEERING who wants to see it.

On another page will be found some interesting reminiscences of the early days of the pop safety valve. These are from the pen of Mr. F. F. Hemenway, lately editor of the *American Machinist*, who was a mechanic in the old Troy & Boston shops at the time Richardson invented the pop valve. He made the first valves, and carried out most of the experiments for Richardson.

The members of the Railway Master Mechanics' Association are not reaping the full benefit of the scholarships which the association acquired in the Stevens Institute of Technology a few years ago. There are only three students this year, and one will graduate in a few months, leaving two vacancies. When the list of students is not full, the association may send students to the Stevens Preparatory School free of charge. The extrance examination to the Stevens Institute is rather hard, but the splendid engineering education imparted in the course is well worthy of hard preliminary effort. A season spent in the Preparatory School will enable any fairly educated youth to pass for the Institute.

There was a bad accident on the London & Northwestern Railway, near Crewe, in the end of December, by which fourteen people were killed and twice as many injured. A freight car was blown out of a siding in front of an express train running at sixty miles an hour. The car was thrown into the air and lighted upon the train. The fragile carriages went to pieces like egg shells, with the result stated. The accident is another argument in favor of stronger cars for our British cousins.

A freight train on the Lehigh Valley broke down the roof and part of it dropped into an abandoned coal mine, at Audenried, Pa., on January 18th. The engine got over, but the tender went into the cavity. The fireman was saved by hanging on to his clinker hook, which was fast in the firebox.

A New Passenger Locomotive.

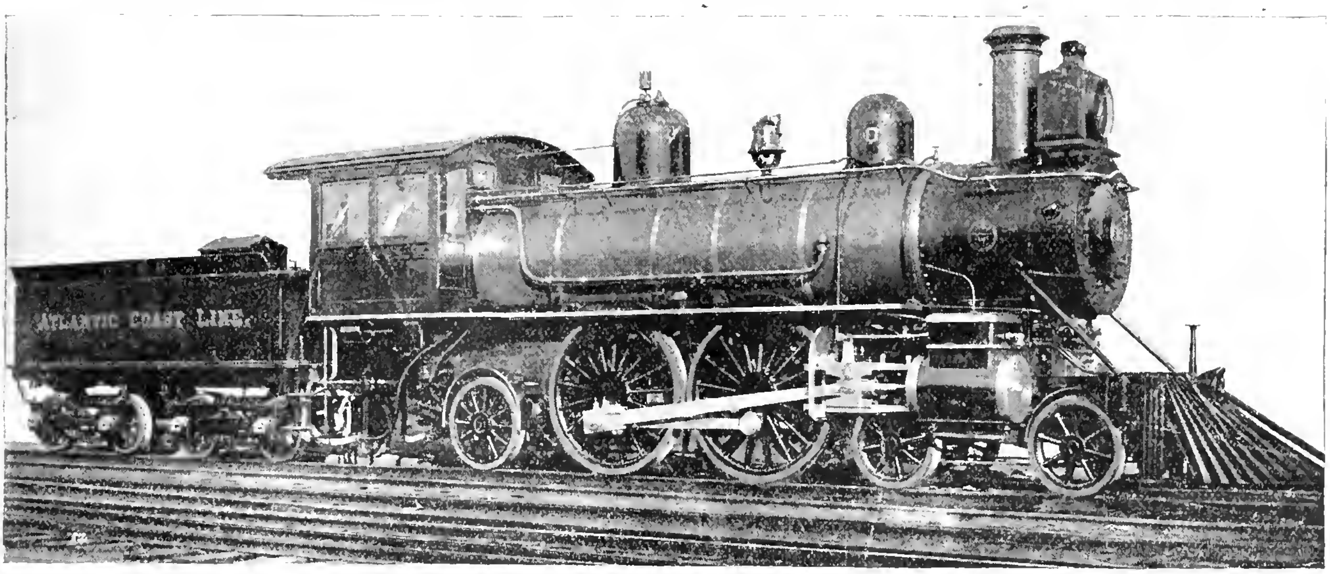
The Baldwin Works has recently turned out, for the Atlantic Coast Line, the first of a class of locomotives designed to haul ten vestibule cars at an average speed of forty miles per hour over grades of thirty-two feet per mile.

Four of these locomotives are in service and doing the work in first-class shape.

The principal departure from the plan of the "Columbia" type is the use of a four-wheeled truck in the place of a two-wheeled one, to guide the engine.

This plan gives a firebox some twelve inches deeper than where the drivers are under it, and still allows the use of wide box—on top of frame.

The following are the principal dimensions of the engine and tender:



NEW FAST PASSENGER LOCOMOTIVE FOR SEABOARD AIR LINE.

Gauge, 4 ft. 9 in.
Cylinders, 19 x 24 in.
Drivers, 72 in.
Total wheel base, 23 ft. 10 in.
Driving-wheel base, 6 ft. 3 in.
Rigid, 12 ft. 6 in.
Weight, total, 125,000 lbs.
" on drivers, 78,000 lbs.
Boiler, diameter, 60 in.
Number of tubes, 258.
Diameter of tubes, 2 in.
Length of tubes, 14 ft. 3 in.
Firebox, length, 90 in.
" width, 42 in.
" depth, 67$\frac{7}{8}$ F., 65$\frac{7}{8}$ B.
Heating surface, F. B., 133.5 sq. ft.
" " tubes, 1,913.7 sq. ft.
" " total, 2,047.2 sq. ft.
Water space, 3 and 4.
Staying, radial, 1$\frac{1}{8}$ in.
Truck wheels, diameter, 36 in.
Trailing, 42 in.
Truck journals, 5 x 10.
Trailing journals, 6$\frac{1}{2}$ x 10.
Driving-wheel centers, 66 in.
" axle journals, 8 x 10 in.
Tender capacity, 3,600 gals.
" wheels, diameter, 33 in.
" journals, 4$\frac{1}{4}$ x 8 in.

EQUIPMENT NOTES.

The Cairo Short Line are in the market for freight cars.

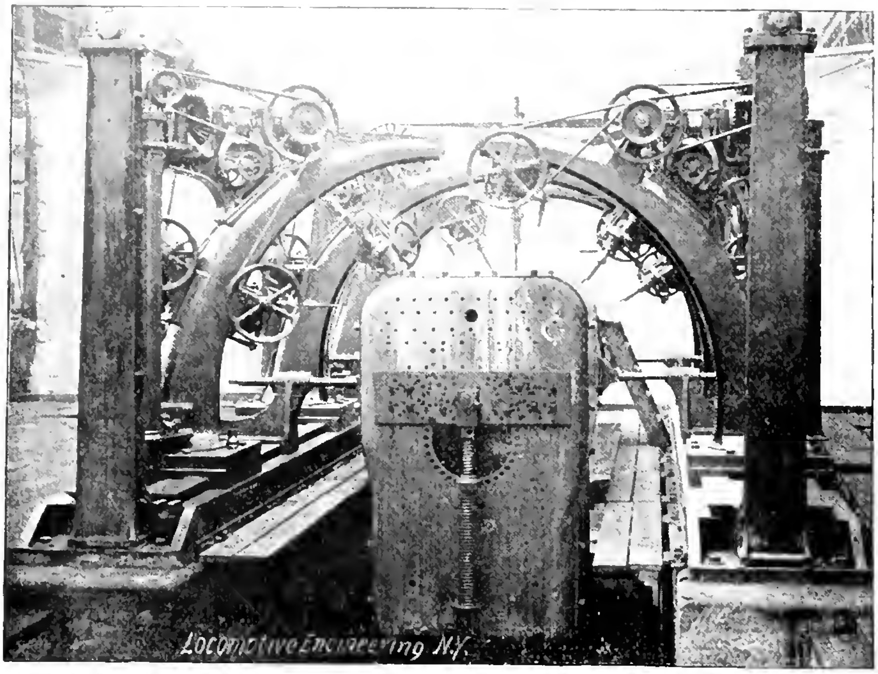
Specifications are out for a large order of cars for the M., K. & T.

The Boston & Maine are receiving bids for the building of twenty-nine baggage cars.

with half force till the rush of orders begins to come in.

The Schenectady Locomotive Works have received an order from the Boston & Albany for ten more of the passenger engine which we illustrated last November. These engines are doing splendid work and are highly popular.

The present condition of the freight-car



PLURAL DRILL—DUBS LOCOMOTIVE WORKS, GLASGOW.

The Wisconsin Central have contracted for the building of sixty heavy logging cars.

The Michigan Central have made a large special appropriation for the repairing of freight cars.

Flint & Co., New York, have received an order to get 200 cars built for the Central Railroad of Brazil.

The Delaware, Lackawanna & Western are about to order 1,000 cars, the half of them being box cars.

The Southern Pacific are about to place a large order for freight and fruit cars. They are also figuring on some new passenger cars.

The Unadilla Valley have ordered one locomotive from the Rhode Island Locomotive Works and ten freight cars from the Carlisle Car Works.

The Brooks Locomotive Works are running half their force, mostly on small orders. In reducing the force, they laid off single men only and kept the married men at work.

The Southern Pacific people have ordered from Schenectady some eight-wheel engines of the same kind as the Boston & Albany passenger engine which we illustrated in November last.

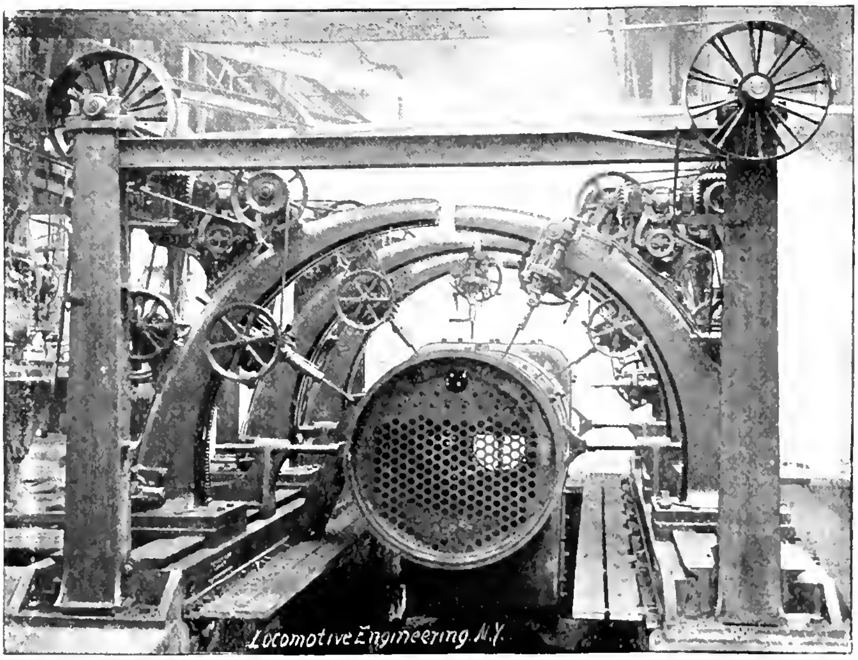
The Peninsular Car Works have received from the Hocking Valley an order for 1,000 cars. They have received several other small orders and expect to keep running

equipment may be judged from the fact that one of the Eastern coal roads has had over 5,000 cars destroyed or put out of service in the last two years, and not a single new car has been built or bought to fill up the blanks. Yet the company is crowded with business. Other roads are in a similar condition.

Several railroad men were talking about different kinds of valve motion, and Mr. John Mackenzie remarked that he had always held a warm place in his memory for an independent cut-off. On being questioned as to the merits of the device which appealed to his favor, he said it was the handle for throwing the cut off into gear. It was this way, he said: "The first engine I fired had an independent cut-off, and the operating lever was on my side. One day, just as the engineer called on me to put in the cut, the engine jumped the track and the engineer was thrown off and killed. I should probably have met with the same fate but that I was holding on to the cut-off lever."

Plural Drilling Machine.

The annexed engravings of a drilling machine which the writer saw at work in the Dubs Locomotive Works, Glasgow, was designed and patented by Mr. C. M. Davies, a mechanical engineer in the works named. There is a very strong prejudice abroad against the practice of punching the rivet holes for high-pressure boilers, and this drilling machine was designed to do the drilling in the most accurate and expeditious manner. The horizontal and vertical seams are drilled under gang drills before the sheets are rolled into form. When the boiler structure is put in shape the principal seams are secured with bolts, and the boiler is set under plural drilling machines to have remaining holes drilled.



PLURAL DRILL—FRONT VIEW.

The drilling machine has a number of headstocks which may be traversed by hand and power in any direction, for readily adjusting the lines parallel with the axis of the boiler. All the details for operating headstock and drills are admirably worked out. There appears to be no point or angle about a locomotive boiler which cannot be readily reached by the numerous drills operated by this machine.

PRACTICAL LETTERS FROM PRACTICAL MEN

A Yankee Engine with a Record in the Antipodes.

Editors :

I recently visited Queensland, and at Brisbane saw an American locomotive with a service record that, I think, stands ahead of anything I have read of.

The foreman told me that this engine had run nearly nine years without being off the wheels. I could hardly believe this, and interviewed Mr. Hornblower, the chief mechanical engineer.

This gentleman stated that the engine was built by Baldwin in 1884, and was put in service toward the end of 1886, and since that time she had made—up to Nov. 7, 1894—190,000 miles. During this time the drivers have never been turned, nor, in fact, removed from the horn plates; the motion bars (guides) have never been closed, nor a tool put on the eccentrics. During this time the engine has worn out two sets of valves, and had two sets of bogie wheels.

Mr. Hornblower had her photographed for LOCOMOTIVE ENGINEERING, and I send you the print herewith.

The engine is 3-foot 6-inch gauge, has 12 x 18-inch cylinders and 48-inch drivers, carrying a steam pressure of 125 pounds.

The boiler has been escanned (inspected) every week when washed out, but a broken staybolt has never been discovered.

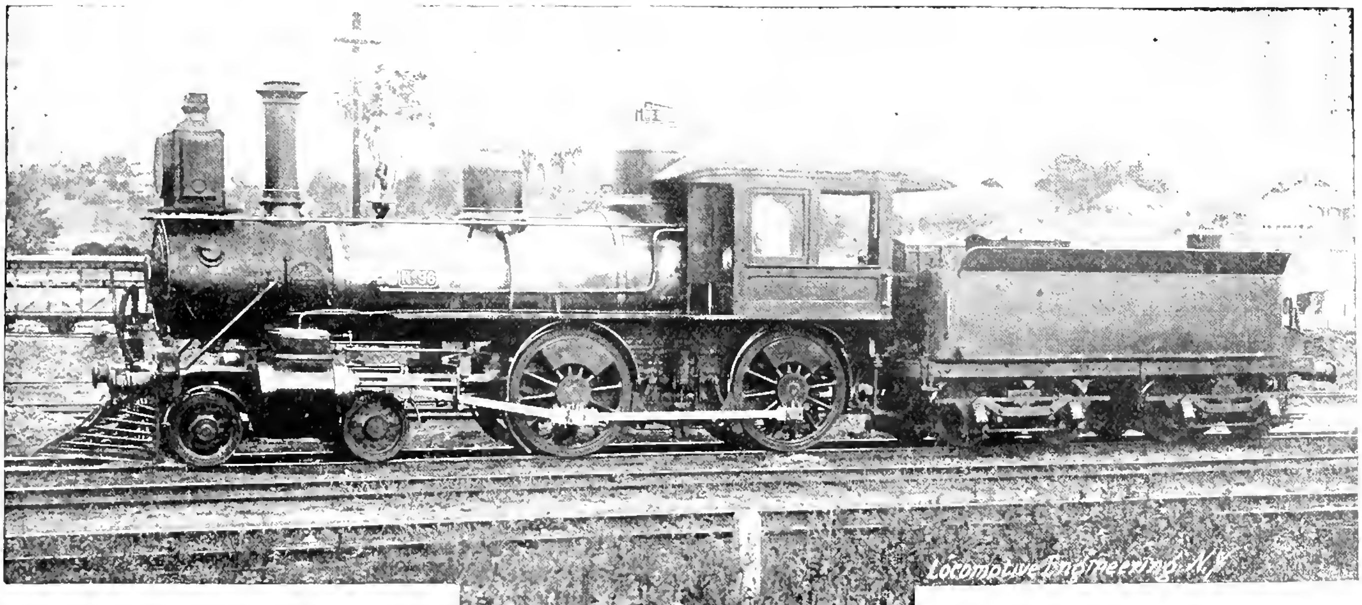
She is worked by Driver James Ratcliff, between Emerald and Longreach, a distance of 259 miles, four runs per week.

The "96" looks equal to another nine-year job, if her tires were turned.

I think this is a wonderful record.

THOMAS HAYS.

Wickham, N. S. Wales.



Straightening Boiler Sheets.

Editors :

I am in receipt of a letter containing a request for an article on straightening light or thin sheets of iron or steel. This is a rather difficult subject to write upon, as it is generally considered a very difficult matter to give a good, sound, verbal explanation upon this matter; consequently, how must it be to write one?

Light sheets, as a general thing, have buckles in them. This is caused by a surplus of metal either in or near the center of the sheet or at the edges. If buckled in the middle the sheet will have a hump there, which, if struck hard enough, will go through to the other side with quite a report, thus forming a hollow in place of the hump. In this case there is a surplus of metal in the center, and the edges of the sheet will require to be drawn or stretched by hammering until they allow the sheet to lie flat; great care must be exercised not to draw the sheet too much in any one place, and turn the sheet over quite often, as it must not be all drawn on one side; also keep working closer to the center of the buckle as the sheet flattens out. On other sheets, where at one end of the sheet one corner will fly up and the other corner on the same end will stay down, the sheet will look a greal deal like a board that is warped; this is caused by a surplus of metal around the edges, and the middle of the sheet in this case will require the drawing or stretching; this, again, must be done very judiciously, as a few blows in the wrong place upsets everything. I think this will be sufficient explanation, as what is needed most by a man to straighten sheets is to use good judgment in determining where the sheet requires to be drawn and how much is needed; this he gains by experience and the use of good common sense.

C. E. FOURNESS.

Dubuque, Ia.

A Point or Two About Air-Brake Handling.

Editors :

In past issues of LOCOMOTIVE ENGINEERING and in Westinghouse Instructions, we have been instructed to place brake valve handle in emergency position and leave it there in order to get emergency action and high braking power immediately. Allow me to submit the fol-

lowing tests, made with a brake equipment: With auxiliary charged to 60 pounds and valve moved to emergency position and left there, brake cylinder shows 40 pounds. With auxiliary charged to 60 pounds and brake valve moved to emergency position, and left there only long enough to get emergency action and then placed on lap, brake cylinder shows 42 pounds—this test shows us that by getting emergency action and placing valve on lap, we get the greatest braking power. I claim that as soon as emergency action takes place, if brake valve is not blanked, the air that escapes at brake valve is only a waste and decreases braking power 2 pounds on each car. Probably some expert will make this test and, if I am not correct, set me right.

We had a car which had no relief valves in auxiliary; they had been broken off on top and bottom and plugged up. This brake stuck on. How could we bleed it off? Some suggested that we knock a hole in reservoir, but, exercising a little thought, we unscrewed plug at bottom of triple and pushed piston to release position, which let brake off.

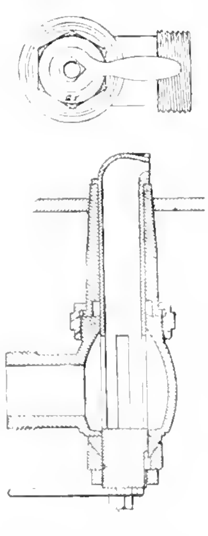
Denison, Tex. W. M. PIPKIN.

[The instructions about putting engineer's valve in emergency *and leaving it there*, referred especially to cases where sudden emergency came up while brakes were in operation on service application. Many men who have studied up, figured that they could stop better if they recharged and then went to emergency, which is dangerous practice in a close place. When the brake is off, it is proper enough to bring valve handle to "lap" after emergency action is had, not because it gives more brake pressure in the cylinder, but because it saves pressure to release the brakes again.—ED.]

A New Boiler-Washing Nozzle.

Editors:

I herewith inclose a cut of a boiler washing device, designed by myself, and in use on the Mobile & Ohio road for the past twelve months, for which a patent is now pending. The object of the device is to keep mud and scale from accumulating in the shell port of the boiler under the flues, and thereby prevent the same from accumulating in and around the flues. I have used this device with remarkable success, and feel satisfied that by its use 50 per cent. in cost of flues can be saved, and at the same time greatly reduce the consumption of fuel.



In 1894 we put in 800 less flues than in 1893, and expect to make a better showing in 1895. This is because we are able to keep our boilers cleaner than we did.

It is a boiler washer's tool, and is screwed into the bottom of the boiler, just behind the cylinders, all boilers being tapered at this point to fit threaded sleeve shown, which is screwed in just far enough to permit the end of right angle of nozzle to throw the stream along the bottom of the boiler, the water hose being connected at side. The operator, by the use of the handle shown at the bottom, can direct the stream at any point inside the boiler and wash the scale and mud down into the water space, where it can be raked out.

The handle can only be attached in opposite directions from outlet in nozzle, which enables the operator to know at all times in what direction the stream of water is being thrown. D. O. SMITH, M.M.

Whistler, Ala.

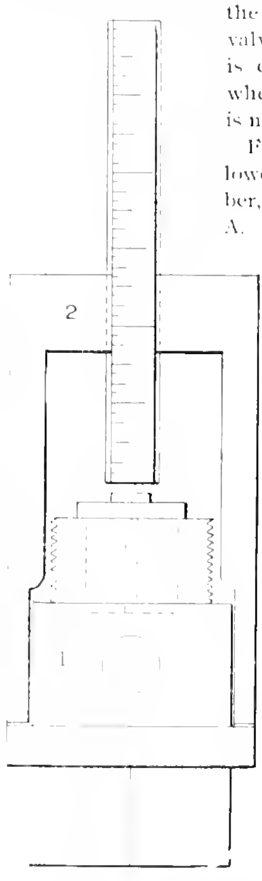
Gage for Regulating Lift of Air-Pump Valves.

Editors:

I inclose you a drawing of a very handy gage that I have designed for regulating the lift of the air valves in pumps; it is especially handy where a quick job is necessary.

Fig. 1 shows a lower valve chamber, cap No. 34, W. A. B. 8-inch pump, with discharge valve No. 32 in position.

Fig. 2 shows the gage (combination height and depth gage); the depth of the valve stop No. 44 is obtained from the upper surface of gage, and the sliding scale being the exact length of the gage body, it moves a corresponding distance, and by placing it on the cap, as in drawing, the lift of valve can easily be determined—can be used for the upper discharge valve also.



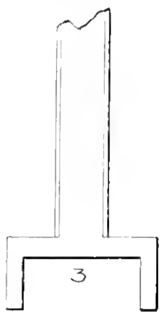


Fig. 3 represents a scale to be used in fitting the upper receiving valve of a New York pump, it being stopped by the upper discharge valve seat and the flat part of valve.

This gage can be made very useful for many other purposes. If it is anything new, it may be of interest to the air-brake fraternity. J. A. JESSON,

A. B. Instructor, L. & N. Ry.

Nashville, Tenn.

Those Broken Wheel Centers.

Editors:

In answer to W. de Sanno's query in November issue, regarding those driving wheels being so badly broken, caused by a broken side rod, I herewith inclose a sketch explaining my theory of the cause.

When the left side rod let go, nothing remained to hold the crank pins in tram, and it is possible that the main pin might

have passed below its center and commenced the back stroke just as the back pin was trying to get over its center, as shown in drawing.

A very little lost motion in pins and brasses would make this possible. Should this have happened, something had to let go. The way the side rod is bent in Fig. 3, shows what a hard wrench the pin got before it let go, breaking out a piece of the hub with it.

The pieces were broken out of spokes *B*, *C*, *D*, *E*, I think, by the detached crank pin coming in contact with them.

A few months ago I was running an engine when her left side rod broke in two, not doing much more damage on that side, but breaking the straps on both ends of right side rod, letting back end down; the back driving axle was also bent badly next to box. If the side rods had been the solid end type, it is hard to tell where the final "let go" would have taken place, possibly the spokes in the back wheel, the same as W. de S. describes.

From the fact of the straps being torn out at the ends of rod, in the case I refer to, the pins must have been in the position shown in Fig. 2 when breakage occurred. F. L. STREET.

Neodesha, Kans.

A Timely Air-Brake Pointer.

Editors:

This is the season of the year when the air-brake apparatus is likely to give trouble and cause considerable annoyance to the inexperienced. A case has come under my observation, which was particularly

annoying to the runner, the relating of which may be beneficial to some who have had similar trouble without knowing the cause.

The case to be observed here is about a pump failing on two different occasions to supply the proper pressure, and, ultimately, no pressure. In the first instance, on arrival at the terminus of the division, the engineer reported the defective pump needed repairs, as it would not run. The engine was put in the house in a stall beside a blooming hot fire, that it might be in comfortable quarters for the machinist. It remained there for a few hours, until the men came in at 7 A. M. The foreman said to the specialist that the air pump on the "282" required his attention. The pump was oiled and it started to run without any apparent defects, pumping up full pressure with ease. This perplexed the operator.

The brake was applied and released several times without displaying or indicating any imperfections. It was allowed to run for a few hours that it might develop its defects, when the applying and releasing were repeated without showing any disorderly conduct. The expert was satisfied that each part of the brake apparatus performed its respective function with usual regularity, and pronounced the pump fit for service. After a few trips the pump was again charged with committing a misdemeanor and being balky on the road. Again, as on former occasion, the engine was ensconced by a glowing fire. Again the specialist was directed to diagnose this case and apply the proper treatment; if need be, perform an operation. The pump again responded with surprising regularity and all parts worked equally well. This seemed mysterious to the expert. He examined all parts without discovering any imperfections or defects. This time the pump was thoroughly renovated.

The specialist watched for an opportunity in the afternoon, in the parlance of the boys, to "jack the engineer up."

Early one cold, frosty morning in the month of January, when the wind seemed to pierce my very soul, when the mercury in the thermometer was registering a notch or two below zero, I overheard a conversation that was not composed of the choicest words. As my friend, the engineer, was usually of a tranquil disposition, I admonished him in his choice of language.

He replied that his air pump had given out on him on this trip, and also on two former occasions; that he had reported it repaired and that it was neglected.

Noticing the struggle the pump was having after a few strokes, and on a few queries from the runner, I decided that her actions were indicative of being frozen up.

"No water in her main reservoir. It was drained before going out on this trip," said the engineer.

"Well, we will see," added your scribe. An emergency torch was completed in a few seconds, from the packing iron and a bunch of cotton waste treated to a liberal dose of kerosene oil. Notwithstanding his vigorous protest, I proceeded to demonstrate the correctness of my theory. The emergency torch was touched off and held beneath the union, at the main reservoir, that couples the pipe from the air cylinder to the main reservoir. Several minutes elapsed without any apparent effect—much to the satisfaction of my friend—but I was not going to surrender my hopes just yet. Presently my efforts were rewarded by the pump striking up a 100-mile-an-hour gait, soon charging the reservoirs. The brake was applied and released to establish that frost was the cause of the pump's failure.

Several such cases have come under my observation, and I have ascertained that the chief causes are, when running through a dense fog, or a slight snow-storm, when the weather is intensely cold, and when the main reservoir is placed beneath the boiler and behind high-cylinder saddles, and when some distance is passed without applying the brake. The moisture brought in through the pump seems to accumulate at this point near the main reservoir, and freezes, thus closing the communication to the main reservoir.

J. F. BARRETT.

Scranton, Pa.

The Farce of Inspecting Brakes at Terminal Stations—A Reform Needed.

Editors:

The following paragraph is extracted from the Westinghouse chapter of don'ts: "Don't leave a terminal station until your brakes have been thoroughly tested and you are sure they are operating throughout the entire train. Instances *have* occurred when somebody neglected his duty and didn't open a stop cock, which you found out only when you attempted to make your first stop. It's better to wait a minute in testing brakes before departure than to muss up things and block the road several hours—longer, perhaps, as the wreck crew may be engaged elsewhere."

I have been very observing as to any and everything in the air-brake line, and have collected rather an unusual amount of information, but in all my experience I have been so unlucky that I have never seen a train of eight or more air-braked cars given a "terminal test" that I considered satisfactory or safe, and I have often had to make the test application and release, myself.

That nervous desire to "get out of town" is the greatest impediment in testing brakes. When the train is brought into the station, the angle cocks between engine and train are sometimes closed before the brakes are released, and it often happens that car inspectors open the angle cock at end of the train and exhaust all of the train-pipe pressure, in order to hold the brakes on while they are working along under the cars, making it safer for them, and showing the condition of brake rods and levers while under a strain. In the meantime, one or more extra cars are coupled on. Those cars have empty auxiliaries. You are not allowed to couple on to your train until all inspection is done, except trying the air, and it is probably leaving time, and the instant that you couple on and angle cocks are opened between tender and train, you are ordered to try the brake. You know that the air pressures in the train have not yet equalized, and you don't want to set your brake until they are, but every second you wait delays the train that much. You have no orders to hold the train after leaving time for just a little thing like trying the air, so you have to exhaust all of the train-pipe pressure to get the slightest application on those cars whose auxiliaries were previously empty. When you coupled to the train with empty train pipe and some empty auxiliaries, the pressure in main reservoir was considerably lowered, and after again discharging the whole volume of air in train pipe so as to get every brake to set, the main reservoir would not have air enough to refill the train pipe with a pressure that would release all of the brakes, and those brakes that are stuck will be *bled off*.

I want to call attention to the fact that an air brake has not been tested when it must be released by opening the release cock under the car. If a brake fails to release naturally, after the engineer's brake valve is in release position, a closed angle cock may cause the trouble, but the inspectors will get your train off their hands quicker, and you will leave just a little nearer on time, by bleeding the brakes than to wait for them to be pumped off—the natural release—but you will give your brakes really their first test when you make your first stop out on the road, and it's much safer testing brakes while standing in the train shed than while running forty or fifty miles an hour.

A triple valve may be "stuck" while the brakes to the rear of it release; therefore, no angle cock could be shut. If the engineer can apply and release the brake on the last car in the train, the *main* pipe is certainly open through the length of the train, but there is a branch or "cross-over" pipe that connects the main train pipe of each car with the triple valve. This pipe, or one of the air strainers in it, may be stopped up suddenly, or the stop cock in this cross-over pipe may have been closed, accidentally or otherwise, preventing the operation of the brake on that car, while the other brakes ahead of and behind it work all right.

The Westinghouse Company make these stop cocks so that the handles will stand out at right angles to the pipe when the cock is open, and they intend the cock to be set in the pipe where it goes across, horizontally. When attached in this way, the cock will not work shut, but under a great many passenger cars I notice the

stop cock is located in a perpendicular section of the cross-over pipe; the handle stands horizontally when open, and it is quite possible for the motion of the car to cause the handle to gravitate down and shut the cock.

There have been many rules formulated and adopted for the government of those who repair, inspect and operate air brakes, and the rules are numerous, but one of the most important things in air braking is the test of the brakes, to be made before starting the train out on the road.

There is no need for any great delay in making a perfect brake test when there is a good and plainly defined rule to follow and when the enginemen, trainmen and inspectors are competent and follow the prescribed rules. Here is an order that, if in effect, might delay a train about a minute, but might save lives, property and money for the company before the trip is ended.

"When testing the air brakes of any train, and after all cars are coupled together, the inspectors, trainmen, or other parties on whom the duty may devolve, must not order the engineman to make a test application of the brakes until at least one minute after all angle cocks and stop cocks in the train are opened, excepting, of course, the cocks at the extreme ends of train lines, that are always closed. And if it will not delay the train, the brakes must not be tested until the maximum pressure is attained in the train line and main reservoir, and the pump governor has checked the action of the pump. In any test the engineman must not discharge more than 10 nor less than 8 pounds of air from the train pipe, and the application must be made in the service stop position of the brake valve. *Brakes must never be tested with an emergency application.* Enginemen will have their main reservoirs charged with air at highest pressure before coupling to a train, and, upon coupling to a train, will give their air pumps a full open throttle until maximum pressure is attained."

Conductors, inspectors, many engineers, and possibly certain officials, wouldn't like to have such an order in effect, because it might delay a train a minute or so. One night, I saw a passenger brakeman display intelligence enough to refuse to bleed the brakes off the sleepers after the Old Timer had made a terminal test by discharging all of his train-pipe pressure; the engine carried no excess. The brakeman said: "Pump your brakes off, and the next time let your fireman try the air and the brakes won't stick."

Most engineers expect brakes to be bled off after they have "stuck" them, and believe that if the triple valve exhausts the air from the brake cylinder when the release cock on the auxiliary reservoir is opened, that the brake on that car is working all right; but it doesn't prove anything of the kind.

As an instance. Down at the other end of the road, a passenger engine was disconnected from her tender to allow for some little repairing, and when they coupled the engine and tender again, they cross-coupled the air hose; that is, they coupled the brake hose from the engine with the signal hose of the tender, and the signal hose on the engine was united with the brake hose on the tender. Brake and signal couplers will not unite with each other, but when the hose on this engine were fitted to couplers the mistake was made of using couplers of one style. When the engineer brought his engine out the brake seemed to work all right, the driver brake did all the braking and he didn't notice that the tender brake didn't set.

Well, he coupled to his train, and the signal pipe of the engine being connected with the brake pipe of the tender and train, he could not supply a greater pressure to those brakes than the signal reducing valve would supply—say 25 or 30 pounds. The train had been standing with brakes applied, as usual, and, as it was about leaving time when the inspector was ready to try the air, no attention was paid to that, and the inspector signaled the engineer to apply the brake. He moved his brake valve to the position for applying brakes and discharged air from the train pipe on the engine, applying the driver brakes, but from beyond that the air was drawn from the signal pipe on tender and train. The brakes being already applied on the train, nothing more could be done, and after the inspectors had run along the train and found the brakes were still set, they pulled the air signal valve on the rear car to signal the engineer to release the brakes, and to show also that the signal line was O. K. Of course, the whistle didn't blow, but the inspectors at the rear of the train didn't know that, and, *as it was leaving time*, they began bleeding auxiliaries to get the brakes off that were "stuck." Of course, they had to bleed them all, and in doing it some air was drawn through from the train-brake pipe to the auxiliaries, and as that pipe was connected to the signal apparatus of the engine, it caused the signal whistle to blow, and the signal was supposed to be all right. When the engineer threw his brake valve into release, he heard his driver brake let off, and was satisfied. The inspectors *bled off* their brakes, and were satisfied, and the train was started out on the road, with every one satisfied that the air-brake and signal lines had been tested thoroughly, while the driver brake was the only means of stopping the train, under the control of the engineer. Luckily, the first stop to be made on the road was at a station, and the road was clear. The driver brakes stopped the train away past the station, and the train and engine were *inspected*, and the trouble located.

WILL W. WOOD.

Terre Haute, Ind.

Doc. Kicks on the Examination.

Editors:

Doc. has got a run now that brings him up where I see him. Last night we had a good long talk; he don't like the examination business, but he is very mild in his kick about it. He says: "What is the use of all this fuss about examining engineers and firemen? It has been going on for four or five years on most all first-class roads, but the trouble with the Traveling Engineer's list of questions is, it is the first one some of the boys have seen in black and white, and it scared them when they took a good square look at it. But, Clinton, there are lots of questions in it that are of no use at all, might as well be left out; lots of them are too hard for any ordinary engineer. Then, the idea of asking a man to pass 100 per cent. on any list! How do you ever expect perfection from anyone? When the report of your committee was first published in the Brotherhood of Locomotive Engineers' *Journal*, there was a big kick from all hands. We got our traveling engineer, Ike, cornered and put a whole lot of hard questions to him; he put up a pretty good argument in return. Ike says, 'What is there about this form of examination you don't like?' 'It's too long,' says one. 'All right,' says Ike, 'pick out some of the questions you think are of no use.' 'Well,' says another, 'what is the use of asking a young fireman 234 questions?' Says Ike: 'Have you read the list over, or do you take some one's word for it? A man that has fired six months only has 12 questions to answer—it ought to be more, than less—and when he has worked eighteen months he gets 26 questions. Now, where in the next list of 143 questions do you find any that a man need not know about to be a first-class man? Talk about asking too many questions, did you ever see the list they use in examining a steamboat engineer? They get a good solid dose, that is worse than any you have got.'

"Ike gave us a lot more pointers, and it set us a-thinking. I find the boys are much more moderate since they have talked it over and read it closely for themselves."

I said to Doc.: "Examinations have come to stay, and all the dispute over it from now out will be on, How hard should they be? You will allow that there is more knowledge demanded of engineers each year, so that a man will have to keep posted right up to date to be first-class. Do you want the examination made to fit a first-class man, or a second-class man?" "First-class, to be sure," says Doc. I said: "If the engineer or fireman is not well posted, it is his business to get there, not have the standard cut down to suit his ideas. The examination is for the purpose of picking out the first-class men and holding all others back till such time as they get to be first-class.

"Have you read the whole report?"

Doc. admitted that he had not; had

read it over, skipped some of it, and heard it talked over by others.

I said, "In the first place, the committee state that good men should be picked out for firemen; that they should be intelligent, fairly well educated, of good habits, and should be examined after six months' service as fireman; that *this* examination should 'not go clear down into technicalities.' Then follows a list of twelve questions. They also recommend that if, in his six months' service, it is shown that he will not make an engineer, he had better be dropped out. If he puts in his time around saloons, gets around late for duty, has a dirty engine and does his firing with his mouth, it should be cause enough to give a better man his place, not try to reform him. He will be the same kind of an engineer. Do you think that is not fair?"

Doc. says: "That don't read so."

We got the report and showed him he did not know what he was kicking about.

Then I said: "Now, Doc, let us reason together. You are opposed to *any* form of examination and hope to break it down, so that a man can get a job on somebody else's good word instead of on what he knows. It won't work. When you go to work on another road, you will have to pass examination on rules, on eye-sight, on air-brake practice, and why not on handling an engine? Will it not be an advantage to you to know just what that examination will be? Will it not be a greater advantage to you if the form of examination is the same on the road where you are going as on your old road, and where we can reasonably suppose you have passed successfully? Will it not be a still greater advantage if you can show your certificate of passing this form of examination previously? That is what a standard form of examination can do. It is not safe to trust a man on an engine who cannot see plain at all reasonable distances and distinguish all kinds of colored signals apart in all kinds of weather. If you have ever seen a color-blind man tested, you know that it is a sad fact that some men cannot tell green and white lights apart; some others are so bad they can't pick out a red light every time. Do you want that man on an engine running on your division? He will tell you he can see well enough, and that the examination is only to get rid of him. Do you want to let a man out on the main line in charge of a train unless he understands the time-card and the rights of the trains running on it? How would you like to be responsible for a new man unless you were sure he knew his business? How would you find out? Take his word for it, or examine him?

"You say that the examination is too hard. Do you want it so easy that poor men can get by it; get set up and discharged after a few months as engineer, and make the crop of engineers looking for jobs any more numerous? While promotion is made so easy and on the 'oldest fireman basis,' is it any wonder that the country is full of men who have run engines? We can't call them all engineers. While there is so much competition for situations and such an over-supply of engineers, it is in the interest of every competent engineer to have the incompetent men weeded out, if the good men are to stand any chance.

"Set your standard higher than it is now; that is the way to make your situation permanent.

"You know mighty well, Doc., that air-brake instruction and examination has improved the air-brake service on any road that has tried it. You know that you are a better air-brake man now than ever before, just because Ike kept you stirred up about it, till you got interested and studied it up to find out *why* it worked just so and no other way. If it has helped you with the air brake, won't it help you just as much about break-downs on an engine?

"If you don't like the list, try making up one for yourself that contains questions on all you think a fireman should know before taking an engine—remember that the examiner *is* responsible for knowing the candidate is capable—you will get a longer list than ours." "But," says Doc., "I don't know enough to get up such a list." Said I, "But you think you know enough to tear down some other man's list; don't criticise anything you are ignorant of." I expected Doc. would get mad at my rough-shod arguments, but he thanked me for showing him the other side, as he had misunderstood what the list was for, but there was such a great kick about it, he took it for granted that it was something terrible. That is what ails others; it looks like a high jump to get over it, especially as it is the first time such a list has been published unless accompanied with answers. If answers were supplied with the Traveling Engineer's Form, it would not be an examination to find out what a man knew—it would be a test of his good memory in holding on to the answers. As to the justice of expecting all correct answers, or 100 per cent., if the questions are all proper and necessary, should they not *all* be answered correctly? First pick out the questions that are not necessary, or fairly stated, and have them taken out, but *all necessary questions* should be answered correctly, if the candidate is to pass a first-class examination. When it comes to promotion, give the oldest fireman a chance; if he has not paid enough attention to his business to be at the top of the list in knowledge, combined with good judgment, let him step down for the man who has. That will give him an incentive to post himself and learn how the best men do the work. With a new man hired as engineer, he should understand how you want the work done on your road before he goes to work; if you want it done in first-class shape, find out if he knows how *before* he goes to work.

CLINTON B. CONGER,
Road Foreman of Engines.

Grand Rapids, Mich.

Bunching Trains on Mountain Grades.

Editors:

In October number of LOCOMOTIVE ENGINEERING we had an article on independent *versus* continuous driving-brakes, our argument being in favor of the former, with the exception of engines in passenger service or engines pulling short trains. Like LOCOMOTIVE ENGINEERING, we lay no claims to infallibility, and perhaps should be satisfied with accepting the editor's note under article, but we have been gathering *facts, not opinions*, for three months, and have come to the conclusion, with several other engineers, that the editors (although being men who are much more thoroughly posted on general subjects than we are) have never handled forty-five cars, all air, on as heavy mountain grades as we have in the Rocky Mountains here, where the speed down mountain for fifteen miles must not exceed twelve miles per hour, and where retainers won't steady train long enough to re-charge without exceeding said rate of speed.

We may be given to vanity on our qualities as air-brake men, but we have handled "hogs" on these mountains with both the independent and continuous brakes, and while we can make the stops and handle our heavy trains with either, the difference in favor of the former, on mountain work at least, is as day to night. In the first place, we are modern enough in our ideas to want to run steady down the mountain and try to average 12 miles per hour the entire distance. It keeps air pump busy to supply air for forty-five cars without frittering it away, making frequent applications or kicking off head brakes; we have no air to waste, and there is a junction half way down and a crossing just before we get to foot of grade. With a 7-pound application we can probably go three miles before we need to release. Say our train line was 65 pounds to start with, there are always a few minor leaks in a train of this length, and while valve has been on lap, train-line pressure has fallen to 50 pounds, our speed to eight miles per hour, and reservoir pressure increased to 110 pounds. Our engine is equipped with continuous brake, and we release; retainers are all turned up—there are none on engine or tender (which weigh 100 tons); the consequence is engine, which has had train bunched (as Brother Wood calls it), runs ahead much faster than train, which makes quite a bad jerk, if retainers hold at all, and, before train line and auxiliaries can possibly charge to 65 pounds, we are going twenty miles per hour. Why? Because retainers can scarcely hold cars, in fact—can't—let alone a 100-ton "hog." On the other hand, with same train and conditions, except our engines have an Eames vacuum driving brake, when we release, can hold engine back against train, where she belongs, until train is properly charged, and our speed is still less than twelve miles per hour;

can then let driving brake off slowly without feeling the slightest jerk, and we are again ready for an application. We can thus go down this or any other mountain at a proper rate of speed, and if anything breaks, can always stop before they are all in the ditch. If, as it now seems, railroad companies intend doing away with the independent brake on mountain grades, retainers should be put on driver and tender triples. The Northern Pacific has some first-class air engineers, and, to a man, those in mountain service voice these sentiments. Am glad Brother Wood appreciates a *bunching* brake. Let us hear from some other mountain engineer on this subject.

The New Form of Examination for Firemen for Promotion, and New Men for Employment, is, we think, a wise step in the right direction. L. D. SHAFFNER.

Missoula, Mont.

[The arguments of our correspondent are good. One of the editors, at least, confesses to having handled air for some years on a Rocky Mountain road, and acknowledges that it is always best to keep train "bunched," but still believes that the independent engine brake is not an unmixed blessing. We can see no good reason for not using a pressure-retaining valve on engine and tender in mountain service, and think they would answer every purpose.—ED.]

The Old-Timers on the State Road.

Editors:

The "opposition" cars on the old Pennsylvania State road spoken of in the December number of LOCOMOTIVE ENGINEERING, known as "Our Line," were very familiar to the writer; also, the hustling for passengers at all way stations. It was the practice for these men to jump off the train before it came to a stop and then "go for" anyone they supposed intended taking the train.

These blue cars had a "possum belly" similar to that under eight-wheel cabooses, for the purpose of carrying baggage, and it was the duty of these hustlers to crawl into the "possum belly" after a trunk, if it could not be reached any other way, and they were about as noisy a set as a lot of hackmen. The legend painted on the side of these cars read: "Opposition to all Imposition. Miller, Jefferies, and the People." There being cars of the Blue Line and cars of the Eagle Line in the same train, of course, competition was sharp.

"Our Line" was run on what was known as the "Slow Line," a way passenger train, but not slow in running time. It was called the Slow Line on account of the many stops, and afterwards known as the "Tub"—at the present time the Harrisburg Accommodation, but in the early days only running to Columbia, Pa.

It was the custom for the State agent (conductor) to call out to the man on the front end (no bell cord in use) the names of stations he was to stop at, there being passengers on the train for these stations.

There was another opposition line put on about the time spoken of, by Hall & Co. Their idea was to have a car that would ride easy (and there seems to be some sense in the idea). In their cars, the flooring was dropped down between the front and rear trucks, about 24 inches, or what would bring the car floor quite on a level with the center of the axles. While there were seats in the car at either end directly over the trucks, and on a level with the platform, passengers going to the center of the car would have to go down two or three steps. The roof of the car was not sunken the same as the floor. What chances passengers in these cars would have in a derailment is one thing; but they *did* run steady.

Indianapolis, Ind. W. DE SANNO.

Putting in Driving Springs or Equalizer Rig on the Road.

Editors:

I have a method for putting in driver spring and hangers different from any way I have seen or read of, and, as I think it is the best and quickest way, especially out on the road, I thought I would give it to the readers of LOCOMOTIVE ENGINEERING to criticise. Measure the distance from tail piece of frame down to tie, which we will say is 3 feet 7 inches; now measure space between driver box and pedestal binder, which we will say is 2 inches—added to first measure makes 3 feet 9 inches. Cut a plank of about 3 x 6 stuff (a brake beam will do) the above length. Now place one end on a tie and the top end at tail frame back of cab step, and *back* engine up on it, and you have engine as high as you could get it with jack. Now, you should have an equalizer hook long enough to use a piece of light railroad iron about 6 or 8 feet long for a lever to catch under top frame. Always disconnect equalizer to put in spring or hanger; you will have no trouble to pull down equalizer. It is best to have hook long enough to use a nut or block between end of lever and frame, to take second and last pull on equalizer. Run engine *ahead* off of block. I have put in driver spring in seventeen minutes, and about four months ago I broke both equalizer hanger (sometimes called fulcrum) bolts, which let engine clear down on both boxes. I ran her up on block, put in new bolts, and was ready to go in fifteen minutes. Of course, it depends a good deal on whether everything works all right. I have spent thirty minutes in getting out hanger gib, and once spent fifty minutes in getting out broken hanger bolts. I have been told that my plan might work with a light engine, but not a heavy one. About a month ago I helped to put in a driver spring in an 18 x 24 engine, and it worked all right. It is simply a question of strength of the block and the tie it stands on. If any one has a quicker or better plan to work with, out on the road, let's hear from them.

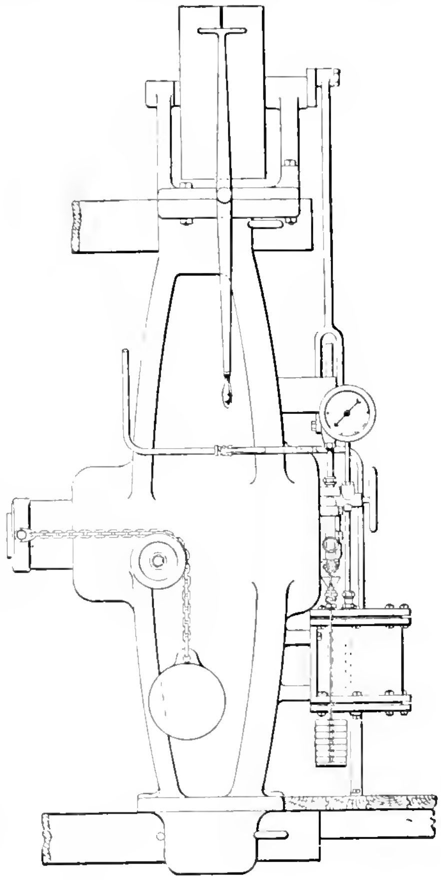
Bartow, Fla. ORANGE POUND.

Some Shop Kinks from the Grand Rapids and Indiana.

[EDITORIAL CORRESPONDENCE.]

You can't go into the shops of the G. R. & I., at Grand Rapids, without thinking you are in a P. R.R. shop. The power is of the P. R.R. style, and most of it came from there, and, by the way, it's the heaviest power in Michigan, and as good-looking as the best.

There is a considerable move in the shop towards expediting work with air, and the demand for more of it has kept the old brake pumps dancing. General Master Mechanic Keegan is building a compressor



WHEEL-PRESS AIR ATTACHMENT.

with which to do the work more economically.

The best thing they do with air is to put some elixir of life in the wheel press with it. Their press is one of the old-fashioned ones with a single pump. In the old days a man put a wheel onto an axle and leaned up against the press, dreaming of home and mother, until the little pump took up enough slack and settled down to business.

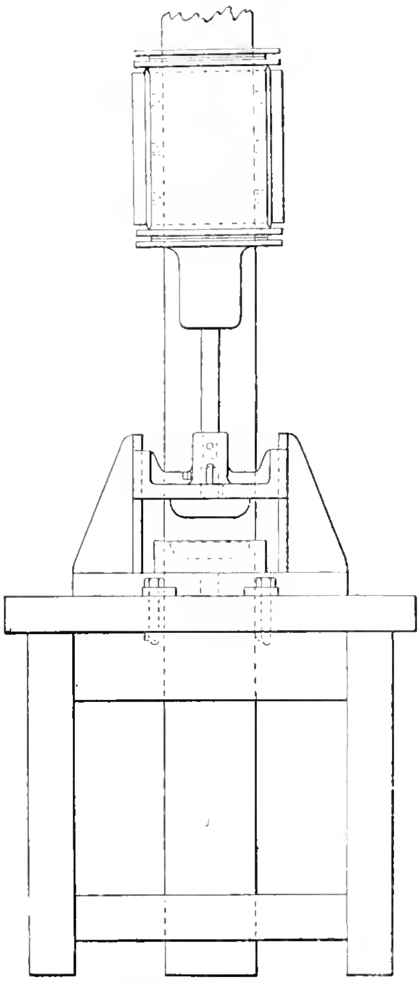
They took off the old open tank the pump used to draw from, and put in its place an ordinary 12-inch brake cylinder, put the pump suction into that and piped air to it.

Now, when they go to press on a wheel, they turn on the air and start the pump at the same time; 60 pounds of air shoves the ram out at once and commences business, and every stroke of the pump increases the pressure—no dream between slacks there. In pressing off wheels it is even better, for

as soon as the air pressure can take care of the work, off it goes in a hurry. It is necessary to provide safety chains to prevent the ram being pushed out of the cylinder accidentally.

Out in the tin shop they have rigged up a press, shown herewith, for pressing out light parts of tin and other light metals—lantern tops and bottoms, oil can parts, etc., the variety of work being limited only by the number and variety of dies provided.

They also handle an ice and snow flanger with air. This device is also shown



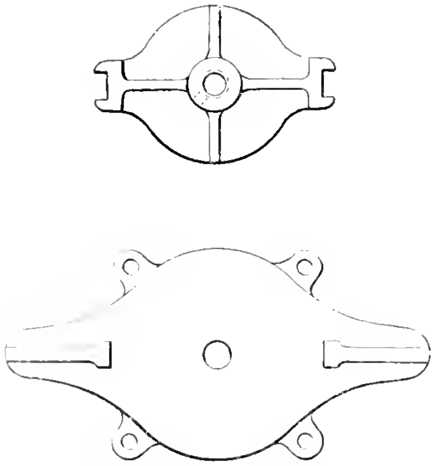
Tin-Shop Air Press.

in sketch. It is in the form of a heavy plow about 18 inches high; on the bottom there are horizontal knives, with saw teeth on them; and this device is dropped between the rails by means of a tumbling shaft, operated by an ordinary tank brake cylinder.

When doing business, they drop it $3\frac{1}{2}$ inches below the top of the rail. It works vertically, which is an advantage over any form of flanger that raises most at the nose.

In the boiler shop they use a flue cutter, designed by the foreman, that seems to be just the thing for getting out old flues.

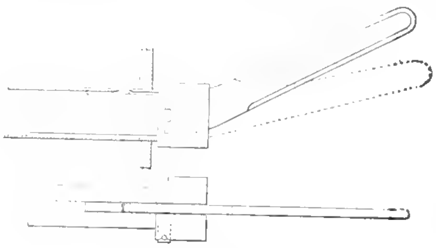
It is a plug that is inserted in the flue up to the shoulder, a knife is pivoted in one end of the plug, and a hole in the other end allows a lever to be used to pry the knife edge against the flue; this cuts a hole in it about three-fourths of an inch long, the handle is slightly turned and another bite taken. The knife is a very stiff piece of



Die and Head—Tin-Shop Air Press.

steel, there being no danger at all of breaking it.

They blow the ashes out of their pans



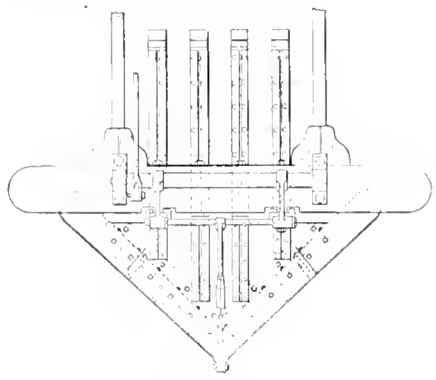
Flue Cutter.

with jets of steam directed from several cross pipes toward the rear damper.

All the engines have large oil cups on their eccentrics—which is a good thing. I never could see why a management would invest in a two-dollar sight-feed oil cup for a side rod where a hole would do first-rate, and be content with a hole full of curled hair for an eccentric where work is done and oil needed. J. A. H.

One of the leading trunk lines, which recently tried a set of Columbian metallic rod packing, reports that it endured the service of 2 years, 7 months, 13 days, during which time the locomotive ran nearly 91,000 miles.

Henry L. Leach, of Boston, manufacturer of the Leach sanding apparatus, reports a sale of forty-three sets for December. Sanding by air jet, instead of by a hole, is a great step in advance; even hard times can't keep down sales of a thing that has so much intrinsic value.

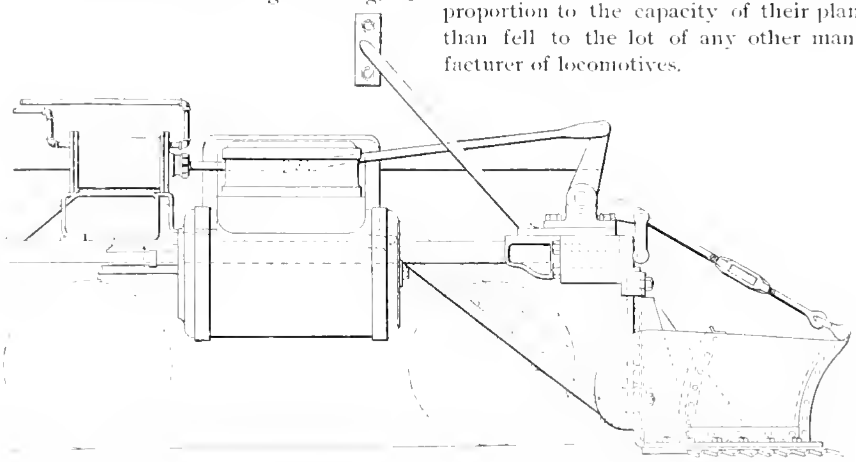


Flanger—Plan.

Steamship heating is a new field for the employment of electric heat, which has attracted the attention of the Consolidated Car Heating Co., Albany, N. Y. Its regular form of street-car heaters are, in the main, well adapted for steamship heating.

On the D., S. S. & A. the passenger brakesmen are stationed at car platforms at all important stations, and require each passenger to show a ticket before entering the cars. It is said to prevent train robberies—the retail kind.

H. K. Porter & Co., of Pittsburgh, Pa., builders of light locomotives, report having enjoyed a larger patronage during 1894, in proportion to the capacity of their plant, than fell to the lot of any other manufacturer of locomotives.

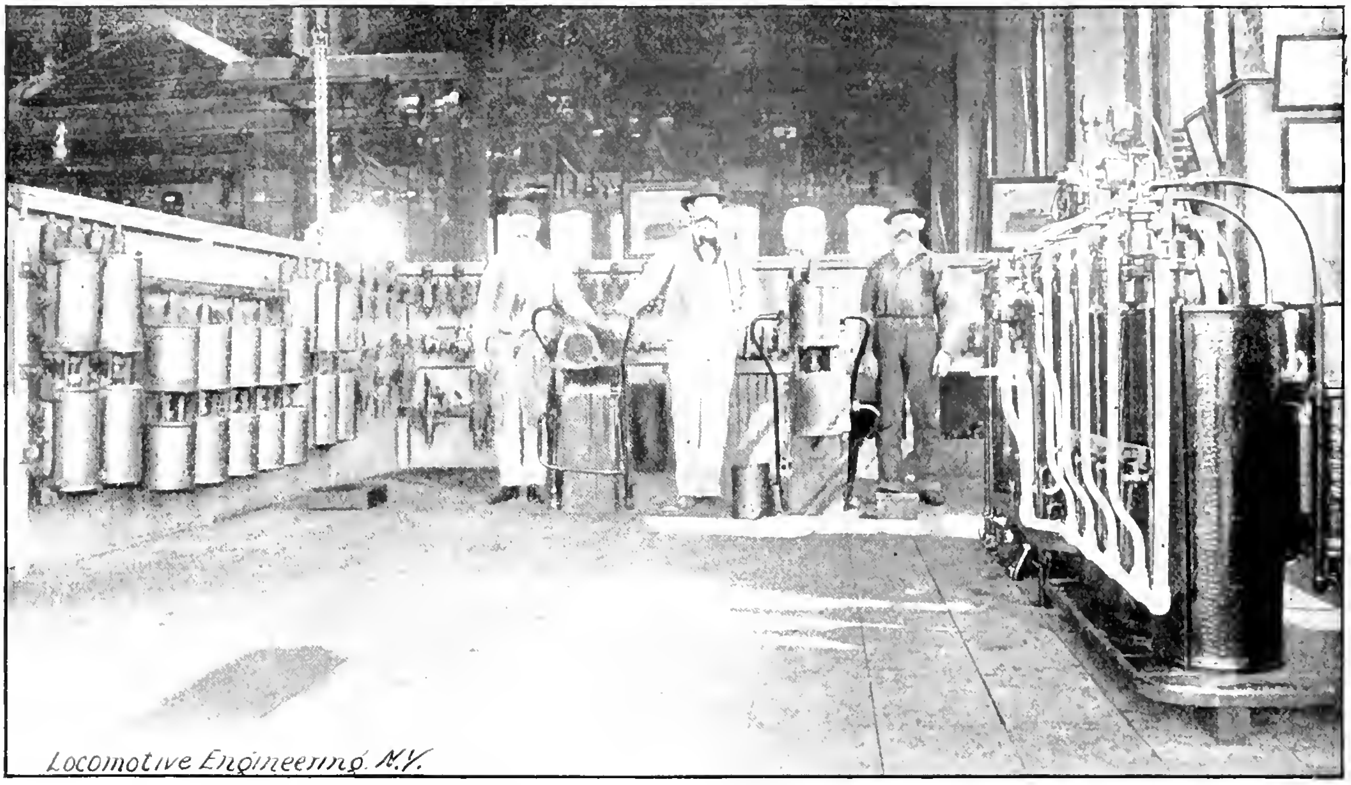


Ice Plow, or Flanger.

A great deal of attention has been bestowed by the electrical papers upon an immense electric locomotive under construction in France. The engine was built according to the designs of M. Heilmann, and was tried upon the Western Railway of France. It proved a complete failure, but the designer is working upon another electrical locomotive which he says will be successful. The leading idea is that the locomotive shall generate its own electrical energy.

A Neat Air-Brake Instruction and Repair Room.

Our photographic reproduction shows a corner in the shops of the O. R. & N. Co.'s shops at Albina, Ore., in charge of Mr. Perry H. Corbett. Here is the usual instruction plant, located on the left, where all kinds of triple and engineers' valves in use by the road are set up in shape to operate; there are also sectional models of the valves, etc.



AIR-BRAKE REPAIR ROOM—O. R. & N. CO.'S SHOPS, ALBINA, ORE.

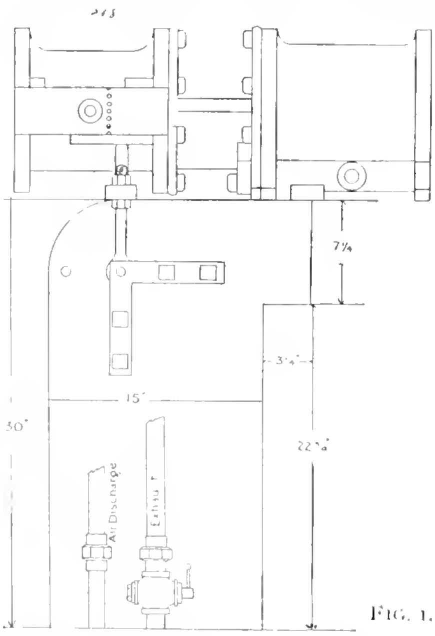


FIG. 1.

On the left-hand side are hung up the pumps, lubricators and injectors that have been repaired and are ready to go out.

In the center and between the men are located two of the best benches for pump work we have yet seen, we show drawings of them.

In Fig. 1 is shown the bench or block with a pump on it in horizontal position; to the lugs on the air cylinder is secured, by check nuts, a hinged bolt. This serves to keep the pump steady; a man can work all around it, and at any moment can throw it up into vertical position by a slight lift on the steam cylinder.

When standing on end, as shown in Fig. 2, the pump comes into position to couple up steam and air pipes, to make a complete test of it before it leaves the bench at all.

Any air-brake doctor can make one of these blocks from the dimensions given.

They lag the air cylinders with old stack netting, which keeps the jacket in place, and perforate the jacket to allow a circulation of air to keep the cylinder cool.

An experiment has lately been made by Mr. Buchanan, of the New York Central, which promises greatly to reduce the annoyance from leaky flues. He believed that leakage was often caused by movement of the flue sheets, due to the inside pressure upon the flat surface. To prevent that, he braced the front and back flue sheets by means of heavy rods run through tubes and securely fastened in firebox and smokebox ends. The results are said to have been highly satisfactory.

The first electric switching locomotive built in Great Britain has just been put into service by a company engaged in making textile machinery. The engine has the appearance of a four-wheel freight car. The driving motor is mounted on a cast-iron bed plate, which slides on cast-iron brackets, bolted to the framing of the car. The motor turns a vulcanized fibre pinion which engages with gearing on the car wheels. The motor is said to work satisfactorily.

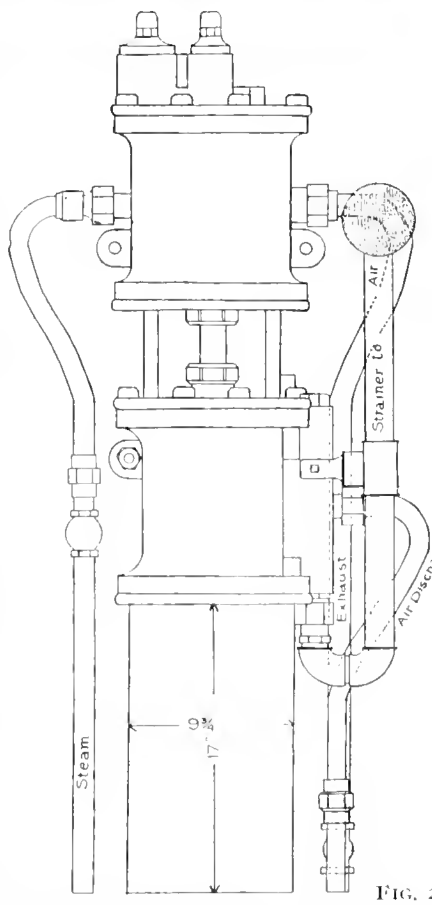


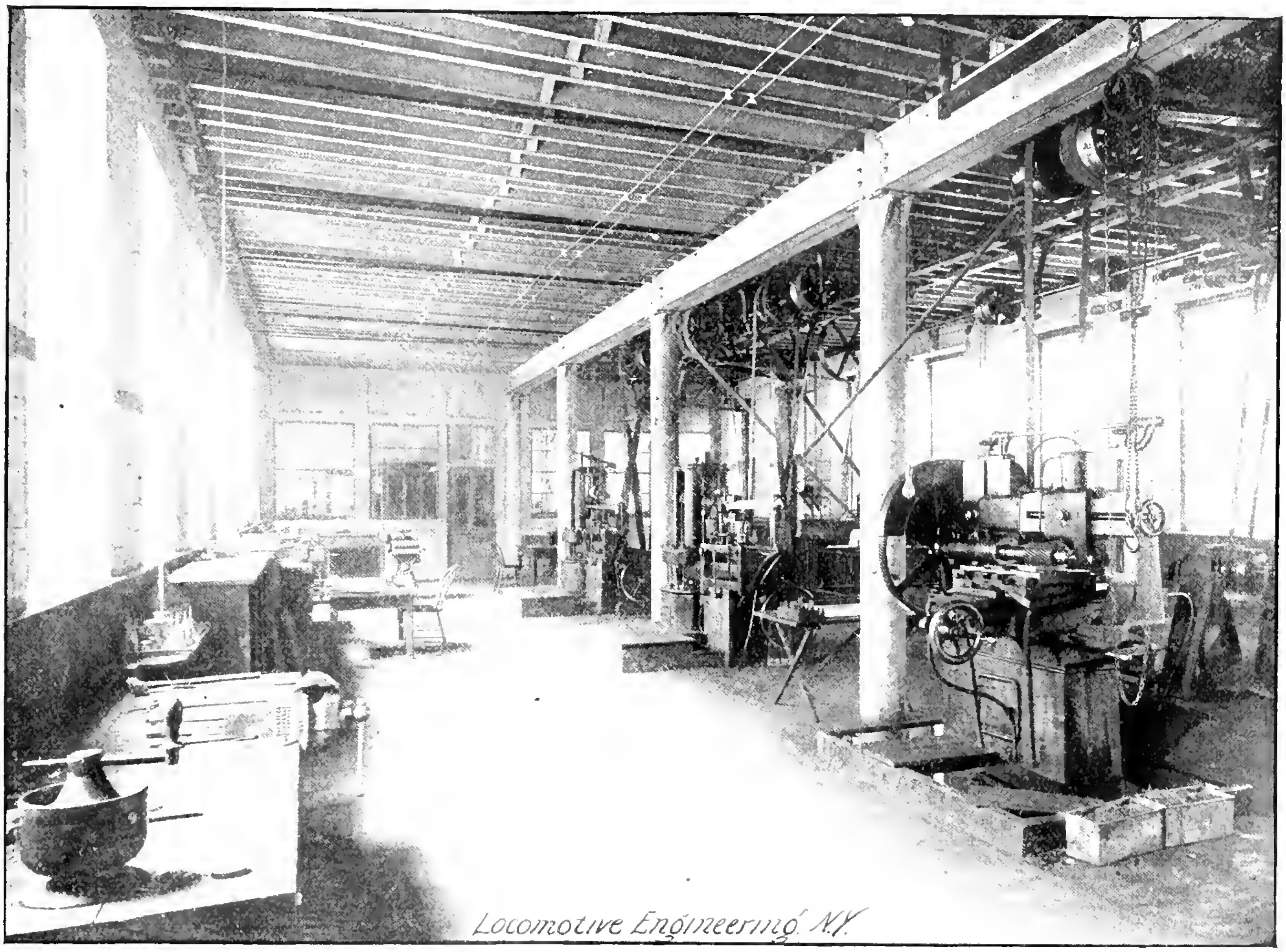
FIG. 2.

Training of Apprentices in Test Department of the Baldwin Locomotive Works.

BY E. A. CUSTER.*

When the Test Department was first organized, it was determined to exercise a close supervision on all material that was offered by manufacturers, so that the standard could be kept at a high degree of excellence, and in doing this to provide a school of instruction for the apprentices. The problem that then confronted us was how to do good accurate work with comparatively raw help. The fact that all the results obtained in the physical tests would be subject to check from all quarters, and that these checks would be made by men who had been in the business for years, were factors that could not be overlooked. Safeguards would have to be thrown around all the work at every stage, the men drilled to perform each operation in an intelligent and systematic manner, and above all, as far as possible, the personal equation in every detail would have to be eliminated. The first step was to equip the room with the best machines for the work. This included, among others, one autographic and automatic, and one automatic test machine, also a special milling tool. Calculating machines, and the simplest and best forms of micrometers were provided. The detail of the department was under the direct supervision of a foreman, whose duties were to see that the records were correctly kept, and to give his personal attention to each operator's work. He was required to break in all new boys, to teach them the use of the various instruments, and to see that each step was thoroughly learned before another was made.

The apprentices were selected with reference to their records while in the shop. Any boy who was bright and intelligent and had the necessary grit to make a good record in shop work, was deemed fit to enter the Test Department. When the apprentice first enters he is put to work on the milling tool in company with the boy who is ready to be moved ahead. He is first taught that all things must be sacrificed to accuracy, and shown that it takes no longer to do good work than it does to do bad. If the test pieces come from his machine more than $\frac{2}{1000}''$ out of parallel, he is made to mill them again, and the source of error is pointed out. In a remarkably short time he is doing first-class work and doing it quickly. During this period, when there is no work for the milling machine, he is sent in company with a more experienced man into the shop, where he bends and tests staybolt iron, match-marks boiler steel, tests flues and rubber hose, and assists in all the observations or tests that may be made. If there should happen to be no work in the shop he is given lessons in micrometer work and the use of the calculating instruments, always being checked up by another operator. By the time he has been in the room a month he is ready to begin on the test machines at odd moments, but must always have another man with him. The first work is making tensile and transverse tests of cast iron, and as he becomes expert in handling the machine, a greater variety is given. It is at this stage that he begins to get an inkling of the manner in which the records are kept, and when the next boy comes along to work the testing machine, the first boy is moved to the calculating table, where he measures all test pieces, makes calculations and arranges the formal notices of acceptance to the various departments. He is taught that no requests for material, notices of acceptance or information of any kind can be given verbally, but must be written. The person receiving a notice of any kind always signs for it, and this system must be rigidly carried out. The boy must not only carry this plan in his own work, but see that it is done by his associates. He



THE TESTING ROOM, BALDWIN LOCOMOTIVE WORKS.

* Engineer of Tests, Baldwin Locomotive Works.

learns the value of leaving a clear trail. About this time he is given charge of much of the routine work in the shop; the tests of asbestos, staybolt iron, flues, hose, selection of coke samples and match-marking boiler steel, all come under his direct supervision. In this manner his power of observation is quickened, the names and different brands of material become familiar, and the experience in handling these products gives him a clear idea of their character and peculiarities. Then, when the opportunity offers, he is given short trips of outside inspection; boiler and furnace steel at the mills, steel billets for forging and brands of iron or steel that are made to special specifications, come under his observation. He handles specifications from almost every railroad in the United States, as well as those from England, France, Germany, Italy, Russia and other foreign countries. His ideas are broadened, and the work has developed so that he not only furnishes information from which deductions are to be made, but also makes deductions from what is before him. In time, if he has the right stuff in him, and applies himself diligently and conscientiously, he has become a trained observer, ready to enter that field where experience and higher education will give him a standing in the eyes of his employers. Should he be a graduate of any of the various technical schools, or show a natural aptitude for the work, he is taken into the chemical laboratory and given a course at practical chemistry. It is not expected that this course will give him more than an inkling of what can be and is done every day by the chemist, but it is intended solely to put another phase of his chosen profession in a practical light. The close attention to detail and the study required to keep up with the varying work given in this department, is an education on lines that will prove of great benefit to him in the future.

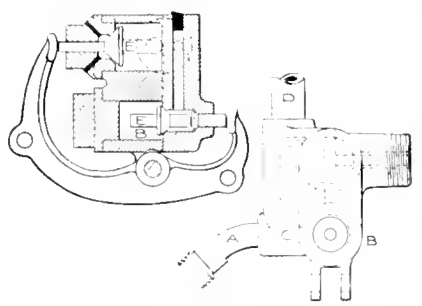
It was at first thought that the apprentice feature would bring out a crop of errors, but the fact is that the continual supervision of all hands at different stages of the work has raised the standard to a high degree of excellence. It is good for both the foreman and the boy, as it keeps the former keyed up to his best work, and teaches the latter something new in his shop education. All the work is done by apprentice boys, under the care of a foreman, and this foreman realizes that the only way that he can do good work is to have each boy do the task he happens to have in a careful and systematic manner.

The U. S. Metal Polish Co., 295 East Washington street, Indianapolis, will send free a trial sample of what they claim to be the most satisfactory material for quickly polishing all bright parts of a locomotive, provided those who apply say they saw advertisement in LOCOMOTIVE ENGINEERING.

We have received the Report of the Commissioner of Railroads for Michigan, which contains much valuable information about the physical condition of the railroads in that State.

Air-Hoist Governing Valve.

The cut shown herewith will give a good idea of the construction of a valve used at



the Juniata shops, P. R. R., at Altoona, Pa., for air hoists. It was designed by F. R. Browne, assistant master mechanic. Where air is permanently connected to hoist, it is brought to the valve at *D*, but where couplings are used, that may be detached, the connection is made at *A*. By attaching cords or chains to the eyelets in the lever, a pull on one or the other will raise or lower the load by operating the valves, as shown. The beauty of this valve is that it cannot be left open; as soon as the operator lets go of the operating cord the valve closes. It cannot be handled roughly, as the openings will not permit air to flow into or out of the cylinder fast. It can be graduated nicely by touching the valves slightly, letting in or out a little air at a time.

There is no book of "answers" to questions in official examination book—study the subject, don't learn a lot of answers.

LABORATORY—TEST DEPARTMENT, BALDWIN LOCOMOTIVE WORKS.

BLOCK SIGNALING

Methods of Operation and Rules.

[SECOND PAPER.]

By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

There are three general methods of operating block signals, under which all the different systems may be classed. These are respectively called the "Telegraphic," the "Controlled Manual" and the "Automatic," the last-named including the "Automatic Mechanical," as well as the "Automatic Electric."

Of these let us first consider the telegraphic method, as, from its simplicity and cheapness, it is in use on more miles of road than any other. Its name is derived from the means by which communication is had between the different block stations for the purpose of ascertaining whether or not the block is "clear."

The equipment of a station consists, primarily, of a signal for controlling trains, which, although preferably of the semaphore type, very often is not; of a lever for working the signal, placed in a position most convenient to the operator; of a wire used in connection with the ordinary telegraph instruments, or an electric bell for conveying the information necessary to properly work the block. The telegraph instruments of a division may all be put on the same wire, in which case it can only be used by one operator at a time, and every other operator can hear what is being said; or else the wire may run from one station only to the next, and thus be a local wire and ready for use at all times.

That there is an essential difference in the manner in which these two arrangements are operated can be seen at once, although the result desired is the same in both. With the first arrangement the train dispatcher is expected to keep track of the operators and see that they properly report to the stations on either side of them the arrival and departure of trains. The dispatcher may be expected, in some cases, to give an order for the "clearing" of each signal, thus making him entirely responsible for the blocking of trains and allowing the operators no discretion in the matter. With the second arrangement, where the block wire extends only from one station to the next, the operator alone is responsible for the proper blocking of trains, reporting their arrival and departure to the stations on either side of him and clearing the signal only when the block is clear. There is, of course, with this latter arrangement the usual train dispatcher's wire in each office, but it has nothing to do with the block system and is only used by the operator to notify the dispatcher of the movement of trains. From this it is seen that the advantages to be gained by using a separate block wire between each two stations are, that it places the responsibility upon each operator and that fewer men will be needed, as the dispatcher will be relieved from the routine work of blocking trains and can devote his time to fixing meeting-points.

Each operator is provided with a train register sheet, on which he records the arrival and departure of trains as reported to him and as he reports to others. The sheet is divided into two columns by a vertical line, the record of all trains in a given direction being placed on the same side. These sheets are kept on file at each station, but should any question arise as to the acts of an operator, they can be sent for and compared with the sheets from other stations.

To prevent operators from making mistakes and giving the wrong signal, there is quite a difference in the means adopted on the various roads.

On some roads, where the signals are normally kept at danger, the operator is required, before clearing his signal for an approaching train, to ask the operator at the next station ahead if he can do so, although his train sheet may show that the last train admitted has passed out of the block. He is not allowed to hook or fasten the signal lever in the position corresponding with the "all clear" of the signal, but is required to hold it there so long as it is necessary to keep the signal at "all clear," a method very certain to insure the signal being returned to "danger" as soon as possible.

Others depend entirely on the train sheet, assuming that in case of doubt the operator will ask the next operator and find out if the block is clear.

Others, again, keep the signal at "danger" only so long as a train is in the block, clearing it as soon as the train has passed the next station.

The first is the best method, as two men, one at the beginning and the other at the other end of the block, have to agree before a train is allowed to enter. Besides, keeping the signal normally at danger is an additional safeguard, as it requires the operator to be certain of what he is doing and to put himself on record that the block is clear.

In regard to the use of permissive blocking with a telegraphic block system, the method most generally adopted is to put the entire control in the hands of the train dispatcher and allow the operator to give a "caution" or permissive signal only when authorized by him. If the conditions as to weather and track are favorable, permissive blocking is frequently made use of between freight trains. But, between passenger trains, the absolute block is maintained unless exceptionally good reasons present themselves for doing otherwise. The permissive signal can be given in several ways, as has been said before; but the best plan, I believe, is to require the operator to give a permissive card to the engineer, the same as with a train order stating for what train caution is to be observed. With this card there can be no mistaking the information given, as might occur with a caution signal, more particularly the three-position signal when such is made by the inclined position of the blade.

That a system of signals operated through the means of communication afforded by the telegraph instrument is cheap and in every way advantageous, is clearly proved from the fact of its having been so widely adopted by roads that apparently could not afford to spend money on anything not absolutely necessary. But one wreck will very often pay for a good many signals and the few extra operators required to work a block system; so that by drawing on one's imagination as to the size of the wreck, it is very easy to figure out a great saving to a road. A system of block signals is certainly a much better arrangement than any practice of flagging trains, but the trainmen must be properly educated as to the extent of the protection afforded by the system and not look for it to do more than it is intended to do. Not that flagging has at yet been abandoned where any system of signaling is in operation, but it is used merely as a check on operator and enginemen in case they should make mistakes.

The benefits to be derived from any system of block signals depends in a great

measure on the rules governing their use and also on the extent to which they are observed. A set of rules for operating a telegraphic block signal system gives, first of all, the definition of a block, defines a signal and then states how the different signals are to be read. As these have already been given—as have, also, several very important points which are usually covered in the rules—I will give in a somewhat condensed form only those which have not been previously mentioned and which are essential to the proper working of a telegraphic system of signals:

Trains between A and X will be governed in their movements by a block system which is designed to protect trains running in an opposite as well as in the same direction. This system will be independent of the general rules governing train movement and the movements directed by special telegraphic orders, and must not be confused with them.

The block signal must never be fastened at the "clear" position, except when the office is closed, but must always be held at that position, when it is desired to clear a train, until the rear car of the train has passed.

When there are no train orders, and the block ahead is clear for an approaching train, the signal should be changed to "clear" as soon and not before the engineer is in sight of it, that the train may enter without reducing speed.

At stations where the block signal is used, a red flag by day and a red lantern by night will be attached to the block signal mast to notify trainmen to call for orders, the block signal in addition being kept at danger until the orders are delivered.

CHICAGO, MILWAUKEE & ST. PAUL
RAILWAY COMPANY.
River Division.

....189..

C. & E. ....

USE PERMISSIVE BLOCK.

From............. .. *to* . ...

Train.............. *entered at* ... *M*.

.... *Operator*.

Engineers and conductors receiving permissive block card will run with great caution. Where view is obscured they must reduce speed to insure against collision with a train that may be running ahead of them.

If no markers are displayed on the rear of the train, the operator at the next block station ahead must be notified to give the approaching train a signal that train is broken apart. The block station in the rear must also be notified that the track is blocked until information is received from the conductor that he has all the cars in his train.

When a train is on a siding clear of the main line and the markers have been seen, the block may be cleared.

The responsibility for colliding with trains when permissive signal is given will rest with train receiving and moving under such signal. This will in no way relieve conductor and engineer of train stopping within block from flagging.

In case of failure of the wires, or if, for any reason, the operator cannot get orders for a train, he must give it written notice of the reason the proper signal is not given.

A train intending to use a cross-over between block stations must notify the signalman at nearest block station. Train shall not use cross-over until a flagman has been sent out.

Signalmen should closely watch each train as it passes, and if anything is noticed that is wrong, must report it to the next station and have train stopped.

The rules governing the use of block signals do not relieve trainmen from observing all other rules relating to the protection of trains.

The rules for use where communication is had by telegraph, generally contain a code of signals by which information regarding the condition of the block can be quickly transmitted. Where a bell is used the code has to be much more complete, and the number of taps required is often large, as one cannot talk with it as is possible with a telegraph instrument. For this reason a great deal of care should be exercised in the arrangement of the code, so that no serious consequences could result from a mistake in counting the number of taps. The best arrangement of taps is that where a combination of numbers, as, for instance, 2-3-2, is used rather than a consecutive number.

While, undoubtedly, there are dangerous situations which may arise with the use of a telegraphic block system from lack of a more complete equipment, it is certainly a great help to the train dispatchers and a protection against collisions. That engineers have run by signals when they were at danger, that operators have allowed trains to enter blocks when they were not clear, accidents being caused thereby, has only resulted in a closer adherence to the rules on the part of the men and stricter discipline on that of the officers. But the fact still remains, that where a human agent is used he is liable at times to fail, and the greater the precautions taken by mechanical means, and by using two men in place of one, the less likely is it

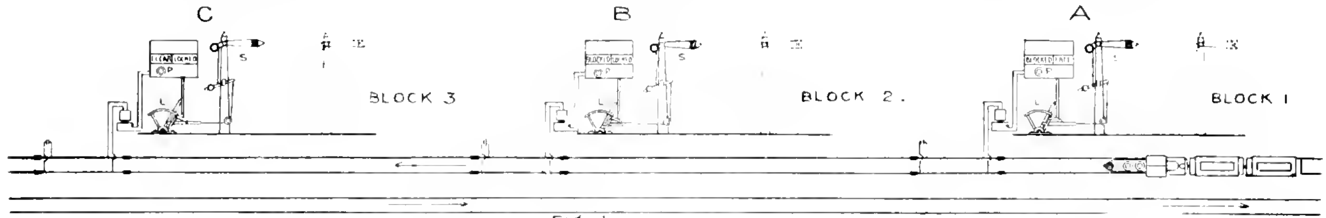


Fig 1

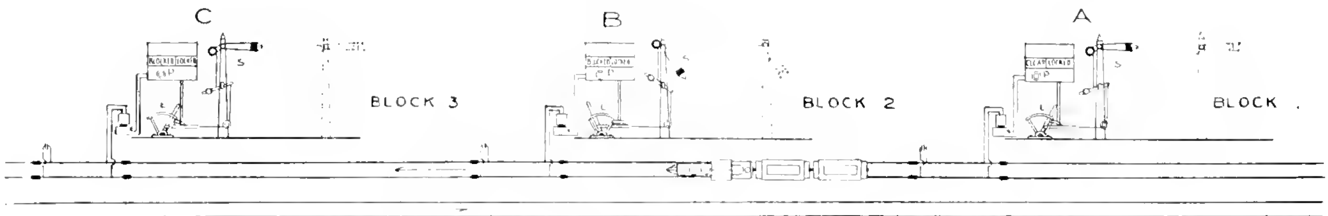


Fig 2

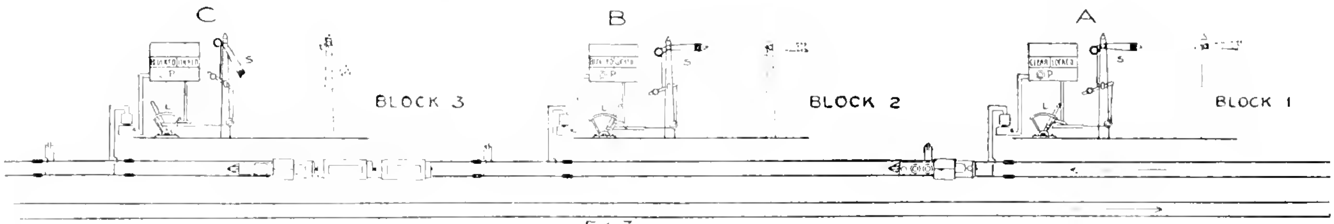


Fig 3

that mistakes will occur and accidents happen.

Work in this direction has resulted in the development of a system in which the labor of two men working in conjunction with each other is required to clear a signal and admit a train to the block. This method is called the "Controlled Manual," of which the Sykes system was the first brought into extensive use, and Patenall's improvement of the Sykes, a later development. Other systems have been invented, but, as yet, have only had a limited introduction. The two systems mentioned have only been applied to roads having double tracks, but another system has been invented, which, although not yet in extended service, accomplishes practically the same results on single track.

The equipment of a station consists principally of a machine having separate levers for each signal, those for the distant signal, if such are used, being interlocked with the corresponding home signal. Distant signals are shown in the cut, as they are to be found at nearly all stations where this method of operation is used, but it is not to be understood that they are a necessary part of any system.

To each of the home signal levers a locking bar and latch are so connected that when the signal is placed in the danger position the latch will fall into a notch cut in the bar and hold the lever in this position. To work the latch, electro-magnets are arranged, with the several parts that comprise the instrument, in a suitable box placed on the machine in a position most convenient to the leverman. There are two indicators in the side of the box, one of which, working in connection with the latch, shows whether the instrument is locked or free. As there are two of these cases, one for each track, and as the equipment for each track is separate and exactly alike, that for one track only will be spoken of.

Wires are run from the machine at one station to the machine at the next station, and so connected with the electro-magnets working the latch that when the circuit is completed by pressing on a contact piece on one machine the latch of the other is lifted and the lever unlocked. This contact piece, which is lettered *P* in the cut, is known as a "plunger," and the operation of closing the circuit, thereby unlocking the lever at the next station, is called "plunging." The plunger is constructed mechanically, so that if the operator has once plunged he will not be able to do so again until the signal has been cleared and returned to the danger position. The object of this is to prevent him from letting a second train in the block before the one admitted by him when he plunged has passed his station. To prevent him from clearing his signal and putting it back to danger again, and thus release the plunger, as might easily happen through mistake, a certain portion of the track is made part of an electrical circuit, and arranged so that the circuit between the two instruments made by "plunging" will be broken until a train has passed over the track circuit. If, now, this track circuit be placed at a certain distance beyond the home signal, it is seen at once that the block will be clear before the operator can plunge and again unlock the signal at the next station.

Working in connection with the plunger and placed just above it, is an indicator which shows the words "clear" or "blocked," for the purpose of indicating whether the operator has or has not plunged. If the operator *has* plunged, then the instrument at the next station is unlocked and a train can be admitted to the block, so that from his standpoint the track is blocked. If he has *not* plunged, then no train can be in the block, and, consequently, it must be clear. It must not be forgotten that the indicator is changed from "blocked" to "clear" when the home signal is returned to the danger position, but that unless the train has actually passed out of the block and over the track circuit the operator cannot unlock the signal at the next station by plunging. A separate wire is strung between each two stations, and used in connection with an electric bell for transmitting the information necessary for the proper working of the signals. Telegraph instruments can be used, if preferred, but as a bell does not require such close attention and can be understood by anyone, it is the one most generally adopted.

In the cut, the levers and signals for a train moving in one direction only are shown. Three block sections with the stations A, B and C are represented, the signals being shown in the proper position for governing the trains which are supposed to be approaching. To make it easier to follow the indications as given by each machine, three positions of the train are shown. The method of operating the signals is as follows: Supposing a train to be in block 1, approaching block signal station A, the lever and signals being in the position shown in the cut. A asks B, by ringing the bell, to unlock his lever if block 2 is clear. B, looking at his indicator, sees the word "clear" and plunges, thereby unlocking A's instrument and changing the indicator on his (B's) machine from "clear" to "blocked." The instruments are shown in Fig. 1 after this action is supposed to have taken place, A's lever being unlocked but with the signals still at danger. A pulls his lever as soon as it is unlocked and lowers the signal admitting the train to block 2. The movement of the lever changes the indicator to again show locked, although the lever is not actually locked until the signal has been returned to the danger position. As soon as the train has passed the home signal, A returns the lever to the danger position and the latch drops into the notch in locking bar, and A is mechanically prevented from again clearing the signal.

As the train approaches, B asks C to unlock him, which C does, provided the block is clear. On B's indicator changing from locked to free, he lowers the signal admitting the train to block 3; the indicator changes back to locked, and we have the condition of things shown in Fig. 2. When the train has passed, B returns the home signal to danger, unlocking the plunger and making the indicator show "clear" again. He could now plunge and unlock A if the circuit was restored; but this circuit is only restored after the train has passed the track circuit, which, as it is

Form 124. CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.

TRAIN REGISTER SHEET.

Record of Trains Passing MERRILL PARK, *November 5, 1894.*

West Bound.							East Bound.							
Train No.	Conductor.	Block Clear or Permission Given.	Passed O. S.	Passed M. S. Arr.	Passed M. S. Dep.	Passed J. N.	Train No.	Conductor.	Time 58 Given	Block Clear or Permission Given.	Passed J. N.	Passed M. S. Arr.	Passed M. S. Dep.	Passed O. S.
		P. M.	P. M.	P. M.	P. M.	P. M.			P. M.	P. M.	P. M.	P. M.	P. M.	P. M.
33		1:28	1:34	1:40	1:44	1:52	26		2:01	2:05	2:08	2:18	2:25	2:34
Ex.	Smith.	3:00	3:02	3:07	3:07	3:14	42		4:03	4:14	4:15	4:27	4:27	4:40

NOTE. Operators will call for 58, and will insert time response is given in proper column, and will fill all blank spaces as called for. 58 meaning to block West Bound trains.

300 feet beyond the home signal, insures that the block will be clear before another train can be admitted.

When the train approaches, C asks D to release him, and we have the condition of things shown in Fig. 3, the operations as above described being again repeated. In Fig. 3 the action of a train on the track circuit relay is shown. The wheels short-circuit the current, so that the magnet of the relay is demagnetized; the armature dropping makes an electrical contact, which restores the unlocking circuit in the instrument.

From this description it is seen that only through the efforts of two men, one at the beginning and the other at the end of the block, can a clear signal be given, and that not until the last train admitted to the block has passed the track circuit can this result be secured.

The rules for operating any of the different "Controlled Manual" systems are practically those for a telegraph system, with only such rules added as are made necessary from the construction of the machine. One, that is perhaps the most important in this respect, is—"In case of failure to get unlocked after operator has plunged, a clearance card must be given for the train to proceed to the next station." Or, the operator, if the rules allow permissive signaling, may signal the train to proceed, using a green flag by day and a green light by night. The bell code of signals is made very large, in order to cover any conditions that may arise.

The blocking of trains by this method of operation has proved it to be much better and safer than one where no check is put upon the operator; so much so, that many prominent men believe it to be the best system of those in use to-day. But, with all this, the fact remains that the personal factor is a necessary part in the operation of the plant, and just so long as this is the case will mistakes occur. While men may have the best intentions and strive faithfully to perform their duties, error is an essential part of human action, and, sooner or later, the time will come when some mistake will be made. Any system that will do away with the personal factor and, at the same time, give as reliable indications, must certainly be in the line of progress toward that perfection and absolute security which all systems strive to attain. The objection to an automatic signal that because no man is on watch the signal may be disregarded, is not valid, for all that any of the systems that have been mentioned are designed to do is simply to indicate the condition of the block controlled by the signal. In any case, faith must be placed in the engineer that he will obey such signals. "The warrant for that faith," to quote the words of Mr. Sullivan, general superintendent of the Illinois Central R.R., "is the fact that no engineman of sound mind will knowingly run into danger. A man will give all he hath for his life—the pledge of the engineman is the highest that can be given."

Many automatic signal systems have been invented, some few of which are in use and giving good satisfaction; others, again, have been tried, and, it is hoped, forever relegated to the scrap pile. The automatic mechanical systems have, as yet, had only a limited introduction. The staff system, while extensively used abroad, has been put in service on but one road in this country, and that for the operation of only one block.

The most successful systems, and those generally alluded to when an automatic system is spoken of, are those which depend upon electricity for the controlling agent, whether or not it is the force actually used to work the signal. Of these, two systems may be taken as representing more clearly than any others the different lines on which automatic signals have been developed. One is the Westinghouse electro-pneumatic, where compressed air is made to work the signal, its action being controlled by electricity; the other is the Hall, where electricity is the only force used. The equipment of the electro-pneumatic system more nearly resembles that of a telegraphic or a controlled manual system than any of the others, as it gives the indications by means of the ordinary semaphore blade. To the engineer the systems are alike, except that he knows that the electro-pneumatic is automatic, and therefore shows exactly the state of the block and not what the operator represents it to be.

A current of electricity run through the rails and energizing a magnet, which is short-circuited by a train, or even a pair of wheels, in the block, is the agent depended upon for the proper working of the system. This magnet, by means of a second and more powerful current of electricity and the action of compressed air, changes the signal to indicate the condition of the block. If the current passes from one rail to the other without going through the magnet, as it will do when the rails are connected by a pair of wheels, the signal is made to indicate danger; if the current of electricity goes through the magnet, the track must be clear and the signal is held in the "all clear" position.

It is seen that if such a system is made reliable and does not get out of order easily, it is an ideal one, having the double advantage of being automatic and using the position signal. The testimony of a superintendent on a road where sixteen miles of track have been equipped and successfully operated for some length of time, shows that the apparatus is reliable and practicable. He says that "there is a failure to give a correct indication only once in 250,000 times, and that the error then is always on the side of safety;" that "without this system the traffic could not be handled on the same number of tracks, owing to the time it would take operators to go through the necessary motions with either a telegraphic or controlled manual system;" that "no dispatchers are needed, as the trains follow each other irrespective of orders, being governed entirely by signals."

The Hall automatic electric signal has come into more general use than the one just spoken of, and is no doubt familiar to most railroad men. This signal differs considerably from those of the semaphore type, in that its indications are given by color and not by position. The mechanism of the signal is placed in a large box having a circular glass center. Behind this glass a red disc is shown for danger; raising the disc out of sight and showing a white background is the means employed to indicate "all clear." The signal is operated by a current of electricity controlled by a track circuit. As long as the current is flowing through the magnet, the disc is held up and all is clear; when the circuit is broken, when a train enters the block, the disc falls and indicates danger.

It is seen that there is practically no difference in the way the two systems are operated, so far as results are concerned, if the difference in the way the indications are given is ignored. Of course, every man is entitled to his own opinion, and while many think there are great objections to giving up the semaphore type and relying entirely on a color signal, others think that the advantages of a position signal are offset by the increased cost of installation and maintenance, that of the electro-pneumatic being greater than that of the Hall. Certain it is that both of these systems are coming more into use every day, as the prejudice against an automatic signal is gradually being done away with. These systems are making a record, both in the matter of expense and the expeditious handling of trains, that other systems cannot approach.

The method pursued in the operation of an automatic electric signal is very simple; the indication of the signal being positive, a train finding one at danger, stops; when the signal clears, it proceeds. As the blocks are generally short and trains can be run as close together as it is safe to run them, the blocking of trains is absolute and no permissive blocking is provided for. Apparently, the only rule necessary is "to obey the signal," but in practice it is found that they, like everything else about a railroad, occasionally get out of order and give a false indication; that is, they indicate danger when the block is clear. If some provision was not made in the rules to cover such cases, it would result in tying up the road until the signal was repaired. Practice on the different roads varies, in the rule adopted for the guidance of trainmen when a signal is found at danger. A reason for this difference is found in the character of the country through which the road runs, the grades and curves, as well as the general difficulties of operation. If the road is easily operated,

the grades light and the country open, the general practice is for a train to stop, when the signal is found at danger, from two to three minutes, and then proceed as under a caution signal. If the next signal is found at "clear," the train proceeds under the clear signal, reporting the block that was out of order.

The practice where a road passes through numerous tunnels, over high trestles and heavy grades, is for the train to stop at signal for five minutes, at the same time sending on a flagman who precedes the train all the way to the next signal.

The writer recently rode on an engine over a division that was equipped with an automatic electrical signal, and had a good opportunity for watching its performance. There were twenty-four tunnels in the 100 miles of road, and it was certainly a great satisfaction to pass a signal showing "all clear" before the train entered any one of them. The trainmen on that division say they "do not see how they ever got along without the signals, and if the company were to do away with them, a good many of 'the boys' would want to 'quit the business.'"

From my experience with the automatic electrical signal, I think it is the system of all others for a road to adopt, for it will show at all times if there is a train or a part of a train in the block, it has no operators to make mistakes, it will always indicate danger when anything goes wrong with the apparatus, and it will fulfill all the requirements that a signal alone can be expected to fulfill.

A railroad superintendent, speaking of the benefits to be derived from an automatic signal, thus aptly describes the difference between a telegraphic and an automatic electric system. He says that "the telegraphic block sometimes goes to sleep, sometimes gets drunk, sometimes becomes insane, and almost always lies when in trouble. The automatic block is a mechanism that has neither the ability to go to sleep, get drunk, become insane, nor to lie. It speaks for itself."

The automatic mechanical systems go a step further than do either of the electric systems mentioned, in that they attempt to stop the train by opening a valve and setting the air brakes, if the engineer disregards the signal and runs by it. It is, perhaps, needless to say that nothing better could be desired in the way of a signal system than one that will give correct indications and stop a train if the signal is disregarded, provided the apparatus is made practicable and durable. But the facts are, that to make the apparatus work successfully the blocks have to be very short, too short for a road running fifty-car trains, and that where trains are run at high speed the life of the apparatus is limited. The mechanical systems, however, have been very successfully applied to elevated roads, where the speed is low and the blocks as well as the trains short.

The staff system, of which, I suppose, nearly everyone has heard, is quite a new thing in this country, and, so far, is giving a very satisfactory performance. There are twenty-one staffs in the two machines, removing one of which from either machine locks both, so that no more staffs can be taken out. Put the staff back in either machine, again making a total of twenty-one staffs, and both machines will be unlocked and a staff can be removed from either. Permissive blocking is accomplished by providing six tablets or tickets, which tablets are unlocked and removed from the machine by using one of the staffs, called a "permissive staff," as a key. Each one of these tablets can be given to a engineer in place of the regular staff, so that it is possible to let seven trains follow each other into the block.

The staff system is, ordinarily, worked as an automatic block, the tablets, or permissive blocking, being used between freight trains, and then only when conditions are favorable. There is only one rule to be observed in the operation of this system, and that is that "no engineer must enter the block unless he has a tablet or staff with him." If the engineer is given a tablet, or the permissive staff, caution must be observed, as there may be other trains in the block running in the same direction.

Before giving the details of construction of the various systems, let me again call attention to the three methods of operating block signal systems, about which this article has been written, and which it is well to bear in mind:

1st. The telegraphic method, where operators can at will clear the signal, a telegraph line being used as the means of communication between the two stations.

2d. The controlled manual, where the work of two men, one at the beginning and the other at the end of the block, is necessary to clear the signal. That a train having been admitted to the block,* the signal cannot again be cleared until the block is clear.

3rd. The automatic, where the signals, either by position or by color, indicate the actual condition of the block. That the signals be entirely automatic, and that, in case of failure, they will assume the danger position.

The office of the Brotherhood of Locomotive Firemen has been removed from Terre Haute, Ind., to Peoria, Ill, and hereafter the *Magazine* will be published from there.

The office of the A. R. U. has been removed from Chicago to Terre Haute, Ind., and the *Times* will hereafter be published from there.

The Elements of Boiler-Making.

SHEET-IRON WORK.

By C. E. Fourness.*

COURSE OVAL AT THE BOTTOM AND ROUND AT THE TOP.

In the first part of this article will be given the bottom course of a smokestack to fit an oval nozzle on a smokebox, the course to be made No. 10 in thickness. It is quite a difficult sheet to lay out, as I know I gave it considerable thought myself before I finally thought out this method. I once asked a boiler-maker who was writing a series of articles—and they were excellent articles, too—how to lay out this, and he gave only an approximate method; but this method is exact. I would say, while on the subject of thinking, that any one who wants to think, or wants to work to accomplish results, will find if they go to bed early at night and get up early in the morning, say about four o'clock, then the brain will be rested, and considerably more work can be accomplished than in the same length of time in the evening after working all day. I, for my part, get up pretty regularly at that time.

Well, to the matter in hand. Fig. 123 is a side and Fig. 124 a front, or rather back, elevation, as the straight seam is shown, and that is usually set to the back. Fig. 125 is a plan or top view. Of a course round at the top and oval at the bottom, the top is 20 inches in diameter and the bottom contains the same area, the ends of which are 12 inches in diameter, and the straight part is $16\frac{3}{4}$ inches long. The area of a circle 20 inches in diameter equals 314.16, and the area of a circle 12 inches in diameter is 113.09; the area of the flat part is $16\frac{3}{4}\times12=201+113.09=314.09$, which is practically the same. There is another matter I will demonstrate right here—that is, that a circle contains more area than any other figure with the same perimeter or outline; consequently, as the circumference must be found, anyway, I will make a comparison of the oval and circle in this case. The circumference of a circle 20 inches in diameter inside is $20\times3\frac{1}{7}=62\frac{3}{4}+\frac{3}{8}=63\frac{1}{8}$ inches, and the circumference of a circle 12 inches in diameter is $12\times3\frac{1}{7}=37\frac{5}{8}+\frac{3}{8}=38$ inches, and the two sides $16\frac{3}{4}+16\frac{3}{4}$ $33.5+38=71\frac{1}{2}-63\frac{1}{8}=8\frac{3}{8}$ inches, the amount the circumference of the oval is longer than the circumference of the circle of equal area. In this case, a separate view from which to get the lengths to lay out the sheet will not be made, as the same results can be gained from the elevation, Fig. 124, without marring the appearance to any extent. Draw *A B*, Fig. 124; then *A C* and *B D*, parallel 30 inches apart and at right angles to *A B*. Mark the point *C* 10 inches, one-half the diameter, from *A* and *D*; $14\frac{5}{8}$ inches, one half the length of the oval, from *B*. Make another point at *H*, 6 inches from *D*, and draw lines through

* Foreman Boiler-maker, C., M. & St. P. Ry., Dubuque, Iowa

the points C D and A H; extend them till they cut and form the vertex E. Draw the line F D at right angles to A E, and from the center F draw the quadrant D G. Space off this quadrant into five points and number them from 1 to 5, beginning with No. 1 at G. Draw ordinates through these points from E, cutting the lines D H and A C. This completes this figure. And now comes the sheet, Fig. 126, and the first thing necessary is the length up the side of Fig. 123, which can be found in different ways. It can be figured by the rule given in the March number on triangles, or found practically by drawing two lines at right angles to each other to represent the perpendicular, which is 30 inches long, as shown—the base equals the difference between the radius of the large end, which is 10 inches, and of the oval, which is 6 inches, and the difference equals 4 inches. This length lay off on the base, then measure diagonally across to the mark on the perpendicular, and this length is 30¼ inches. Another and easy method if a person can work to a scale—call it one-half size, and measure across diagonally on a two-foot square from 15 inches for the perpendicular to 2 inches for the base, and find 15⅛ inches is the length, which, doubled, equals 30¼ inches, the length wanted. Again, by figuring

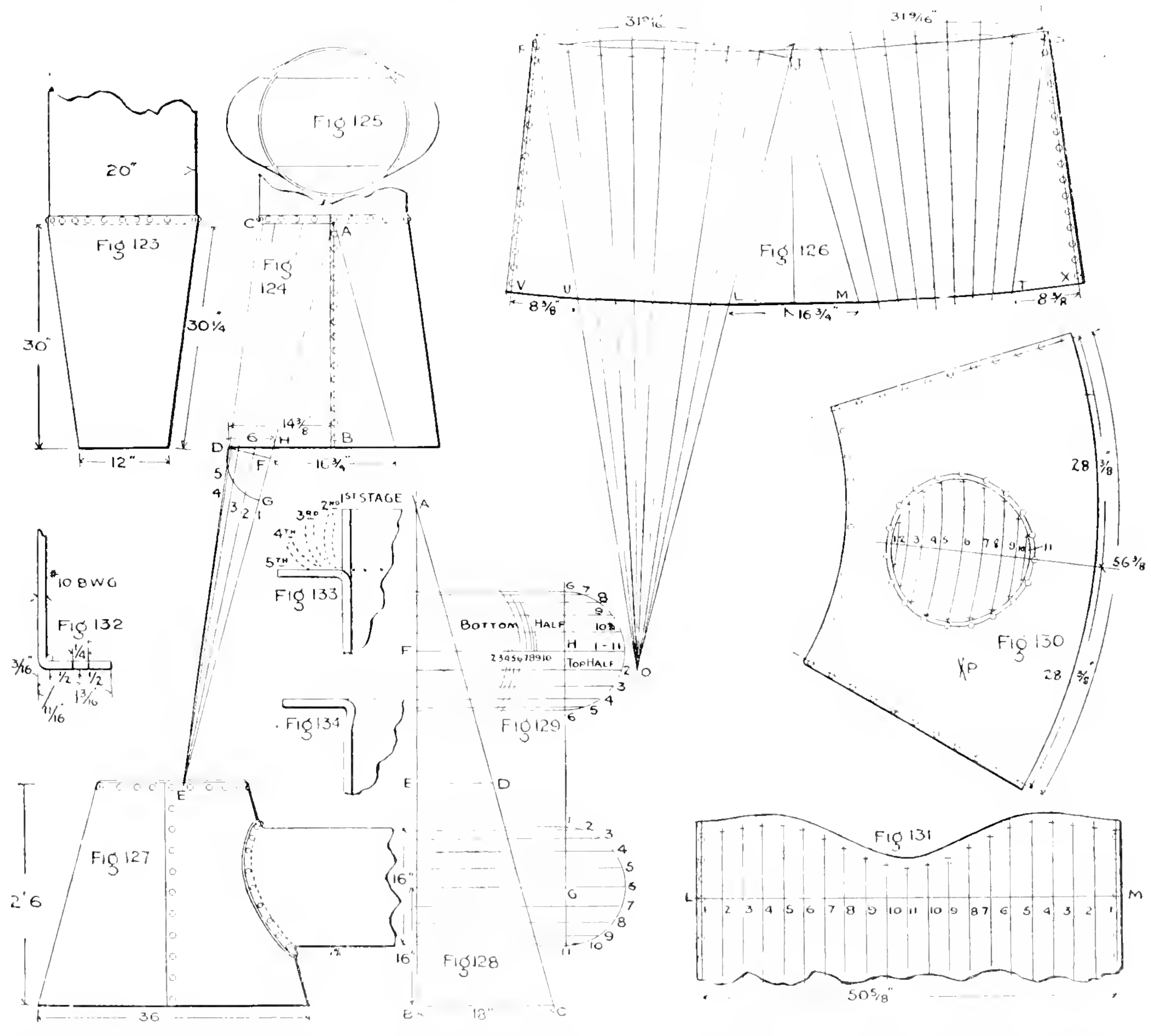
$$^{2}30 + {}^{2}4 = {}^{2}\sqrt{916} = 30.26.$$

I do not give these several methods because I think the length in this case is so difficult to find, but some of these methods may come handy on some other jobs. Now, as the length has been secured, draw the center line J K 30¼ inches long, then L M 16¾ inches long (the length of the flat side), at right angles to J K and 8⅜ inches each side of the center K. Draw a line through J and L to O, and through J and M to P; set the trams from A to E, Fig. 124, and with this length from the center O draw the arc J R, and from P draw J S. The circumference is already found to be 63⅛ inches; consequently, locate the points R and S one-half of this distance, $31\frac{9}{16}$ inches, on each side of the center J. Space off these arcs into nine points and number them—the outside ones, No. 1 running up to No. 5, for the center line. It will not be necessary to bother about the circumference of the bottom, as this is laid out similar to a cone, and that takes care of itself. Set the trams to the length of the ordinate No. 2, Fig. 124, from E to where the line A C cuts the ordinates; transfer this length to the lines No. 2 in Fig. 126. Measuring from the centers O and P, convey the lengths of the other ordinates in a similar manner from Fig. 124 to Fig. 126, and these points will represent the line for flanging at the top. A line drawn ½ inch above these marks will represent the line of rivet holes; although I only show the hole for the front and the one for the back, as the top must be flanged, and the holes, some of them, will be closed, and others stretched to a certain extent in flanging, consequently, they had better be left blank and marked off after being fitted. Draw another line ½ inch above the line of rivet holes, or 1 inch above the line for flanging; this allows the lap. For the bottom, convey the lengths of the ordinates, Fig. 124, from E to the line D H B, to the similarly numbered lines in Fig. 126, measuring from O and P. Draw a line through these points, and for the opposite flat side, as one-half will be on each end, set the dividers to 8⅜ inches, and with one point at T describe an arc at X, then from U describe an arc at V. Then from R and S, with the trams set to 30¼ inches, cut the arc at X and V, draw the lines for the straight seams R V and S X, and space it off for fifteen holes; allow ½ inch outside of the holes for lap, then draw the lines V U and T X, after which being accomplished the sheet is ready to shear and punch.

CYLINDER INTERSECTING A FRUSTUM OF A CONE.

Fig. 127 is a side elevation of a cylinder intersecting a frustum of a cone at right angles to the axis, Fig. 128 is an outline view from the side, and Fig. 129 is another view from the top. As these two last views must be had in order to lay out the sheets, it will be in order to draw them. Draw A B, then B C and D E parallel to each other and at right angles to A B; locate C one-half the diameter from B, or 18 inches; then draw A C. Draw J G and F H parallel to B C; J G to be drawn 16 inches above B C and F H, at any convenient point far enough above E D to clear every thing nicely. Then draw H G parallel to A B, and any distance from the figure; then from the centers H and G draw the semi-circles to a diameter of 16 inches, as shown. Space them off into eleven points, draw ordinates through these points, and draw them long enough to cut the line A B. Number the ordinates in Fig. 128, beginning with No. 1 at the top and ending with No. 11 at the bottom. In Fig. 129, this being a plan or top view, No. 1 will be the middle ordinate; and, in order not to confuse the numbers, will take one-half for the top, the other one-half for the bottom; consequently, as the top one-half is numbered from 1 to 6, will number this half in the same manner, ending with No. 6 at the side; then start with No. 6 on the opposite side and end with No. 11 at the middle again. Set the dividers to the length of the ordinate No. 2 between the lines A B and A C, and with this length from the center F draw the arc cutting the ordinate No. 2; set the dividers to the length of the ordinate No. 3 between the lines A B and A C, then from the center F describe an arc cutting the ordinate No. 3. After all these lengths are conveyed to Fig. 129, measure the length of the ordinate No. 2 between the point where the arc cuts this ordinate and the line A B. This length mark upon the ordinate No. 2 in Fig. 128, measuring from A B, and mark it No. 2′; this gives the distance the cylinder encircles the cone at that point. Again, measure the length of the ordinate No. 3 between the point where the arc cuts this ordinate and the line A B in Fig. 129; convey this length to the ordinate No. 3 in Fig. 128, measuring from A B, and mark it No. 3′. Convey the lengths of all the ordinates in a similar manner and mark them 4′, 5′, 6′, etc., after which being accomplished these figures are complete. So now for the sheets, and first in order comes the cone. This will be made in halves, in order to cut the sheet to less waste. This cone is 36 inches in diameter at the bottom; $36 \times 3\frac{1}{7} = 113\frac{1}{8} + \frac{3}{8} = 113\frac{1}{2} \div 2 = 56\frac{3}{4}$ inches. Set the trams from A to C, Fig. 128; and with this distance upon the piece (or sheet) of material of which the envelope of a frustum of a cone is to be constructed, draw the arc forming the bottom. Lay off on this line for the straight seams the length found, 56¾ inches; also make a mark for a center line one half the distance, or 28⅜ inches, from the ends, and draw a line through these points towards the center. Set the trams again from A to D, Fig. 128; and from the center from which the first arc was drawn, draw the arc forming the top; then draw another arc ½ inch inside of the last for the rivet holes. Space off the arc and the straight seams for the required number of holes; allow the lap at the straight seams. And now for the opening at which to rivet the cylinder. Set the trams successively from A to where the ordinates 1, 2, 3, 4, 5, etc., cut the line A C, Fig. 128; and with each of these lengths from the same center in Fig. 130, draw the arcs across the center line and mark them 1, 2, 3, 4, 5, etc., as shown. Then, with a piece of belt or strap as near the thickness of the material used as possible, mark the length of the arcs in Fig. 129 between the center line and the ordinates Nos. 2, 3, 4, 5, etc., keeping the strap on the outside of the arcs, and numbering each of these marks the same as the ordinate from which the length was taken. Then mark these lengths upon the correspondingly numbered arcs in Fig. 130, and these points, after the sheet is rolled up, will represent a circle just 16 inches in diameter, the diameter of the cylinder inside. Now for the rivet holes, and the first dimension required is the distance the holes are located from the root of the flange or from a line with the inside of the cylinder. The method I use to find this is shown in Fig. 132. This is an enlarged section through the flange, and shows the point very plainly, viz., that the radius of the circle to which the root of the flange was turned must be added to one-half the width of the flange, and in this case it equals $\frac{11}{16}$ inch—see Fig. 132. Mark this distance, $\frac{11}{16}$ inch, outside of the points forming the inside of the cylinder in Fig. 130. Draw a line through these points, and space it off for any number of

holes the job may require; in this case there are nineteen. Draw another line ½ inch inside of the line of rivet holes, to cut it out by for the lap. This, if you will notice, takes off the original marks by $\frac{3}{16}$ inch, and will leave the cylinder all clear and nice, and completes this figure. After this half has been sheared and punched, mark off another similar piece, excepting the opening for the other one-half. And now for the cylinder, Fig. 131. This is these lengths upon the correspondingly numbered lines in Fig. 131, measuring from the line *L M*. Center-mark each of these points just found, to preserve them as a guide for flanging. Draw a line 1 inch outside of these points, or center marks, for the flange. Space off the remainder of the sheet for the required number of holes, allow the lap outside of the rivet holes, and this sheet is finished. After this course is flanged, set it up against the cone to fit; instance—the outside edge of the flange on each side is $1\frac{3}{16}$ inches larger than the inside of the cylinder, as it started from 16 inches, and the total diameter after flanging is $16 + 1\frac{3}{16} + 1\frac{3}{16} = 18\frac{3}{8}$ inches; consequently, to obtain the extra metal required, the edge of the flange must stretch enough to supply this deficiency, and as a consequence, in knocking this down, start at the center marks, and hammer it back as shown in the different stages. If these



16 inches in diameter inside; $16 \times 3\frac{1}{7} = 50\frac{1}{4} + \frac{3}{8} = 50\frac{5}{8}$. This length lay off on the line *L M*, Fig. 131, and draw lines for the straight seams at right angles to *L M*. Space off *L M* into twenty-one points, counting both straight-seam lines. The straight seam will be placed at the top, as it will require less flanging at this point; consequently, start with No. 1 at the seams and end with No. 11 at the middle. For the line of flanging, measure the lengths of the ordinates in Fig. 128 between the line *H G* and the points marked 1', 2', 3', 4', 5', etc. In the case of Nos. 1 and 11, measure between the lines *H G* and *A C*. Mark then, after fitting, draw a line $1\frac{1}{16}$ inch from the inside of the course or the back of the flange. Set it to place on the cone so the line coincides with the rivet holes in the cone by which it is to be riveted to the cone, and mark off the holes.

As there is a cylinder to flange in this article, perhaps a few hints on how to handle it in the shortest, easiest and best manner will not be out of place. Fig. 133 shows the flange in the first, second, third, fourth and fifth stages, when being knocked down—the first and fifth being shown full, the others in dotted lines. Notice, in flanging a cylinder—this one, for directions are followed and care taken, the flange, when finished, will look as shown in the fifth stage, Fig. 133; also, in case the flange cannot be knocked down in one heat, the edge is in no danger of being overheated, as if it were over more. Some will say (I have heard the expression used) it is easy enough to flange it that way on paper; but I can assure you that the person does not flange it like that on paper the first time, either, but it requires heaps of practice and use of brains—it is not acquired by playing cards and wishing you could do it as well as some one else, but by *hard work*. But to the sub-

j 't —no doubt every one around a boiler shop has seen a cylinder (something round) flanged, and when it was finished it would look like Fig. 134. I will explain why it assumes that shape: the edge, as stated above, must stretch considerably to furnish the extra metal for the larger diameter at the edge, and notice, by starting at the center marks that part is strong and holds the sheet to place. In flanging, Fig. 134, the edge was knocked over first, and as the sheet was weak at the center marks, so, in place of the edge stretching the whole amount as it should, it crowded in the root of the flange as shown.

Slow-Releasing Tender Brakes.

One of our correspondents suggests that where tender brakes stick and are slow to release, the trouble is in the use of a 12 x 33-inch auxiliary with an 8-inch cylinder. He suggests the use of a larger pipe between auxiliary and cylinder, to add capacity to the cylinder. He says he knows this is not the right thing to do, but that it's a way out of the difficulty, and goes into figures to show the sizes of pipe needed to fix up oddly-matched equipment.

This reminds one of the old doctor—a specialist. A consumptive came to him for treatment, told his trouble and spit a little blood to show how bad he was. "I ain't much on lung trouble," said the specialist, "but I'll tell you what I can do. I'll give you something to throw you into fits, *and I'm death on fits.*" There is only one remedy for an 8-inch cylinder and a 12 x 33 auxiliary—put on a 10 x 24 auxiliary or a 10-inch cylinder.

A New Way for Counterbalancing Driving Wheels.

Superintendent S. M. Vauclain, of the Baldwin Locomotive Works, has recently perfected and patented an ingenious machine for applying, or rather regulating the application of counterweights to locomotive driving wheels.

Instead of waiting until the wheel is practically finished and on the axle, before applying the needed counterweight, Mr. Vauclain performs this operation the first thing—when the wheel comes out of the sand.

The machine proper consists of a base and a tilting table, as shown in the engravings. This table rests on knife edges, as shown at *b* in Fig. 1, and can be locked level by means of the levers operating the blocks *S*.

The table *B* has a center pin that extends up into the axle hole in the wheel center, as it lies flat on the table, and a cone C^1 for centering and holding it.

The crank-pin hole is brought opposite a long slot in the table, from which is suspended a weight carrier, set the proper distance from the center of the wheel to represent the stroke.

The amount of counterweight considered necessary having already been figured out, this amount of weight is hung on the rod D^1. The weight hanger *F* and its weight are simply to balance the weight of the pin *D* and its hanger. The table is balanced evenly before either of these hangers are put on.

Lead is poured into the cavities c^2 until the weight of the load D^1 is overcome, and the table with its load is again in equilibrium. A pointer b^1 on the pivot *b* shows when the table is balanced.

There is no doubt about getting the counterweight right and in the right place with this device—but all depends on whether the necessary weight to be added has been correctly computed.

FIG I

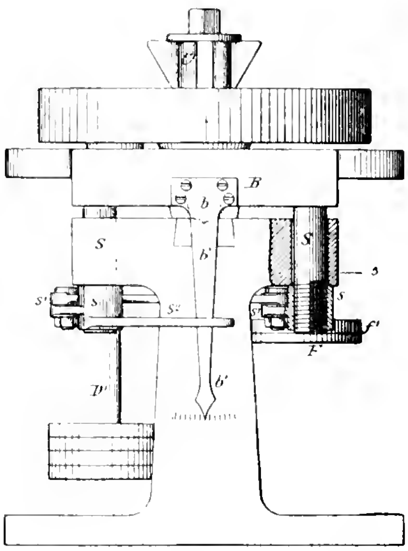
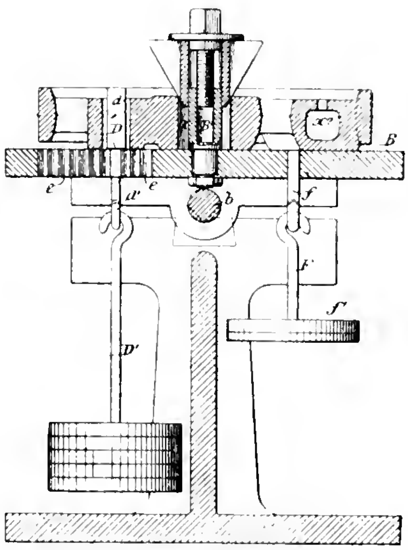


FIG 2



Work of the National R.R. Blacksmiths' Association.

The committees for this association have been appointed to report on the following subjects:

Axles, best methods for preparing scrap for, and manufacturing.

Springs.

Hydraulic forging, bull dozer, forging, bending and cutting machines, hammer dies, etc.

Electric welding.

Tool steel, tool making, tool dressing, tempering of tools, uses and treatment of low and high carbon steel, self-hardening steel, its advantages, etc.

Locomotive frames, report on best method for making and repairing of same.

Furnaces and fuel, to consider and report upon the best design for economy in fuel, etc.

Proper material for and best methods of making side rods, crank pins and motion work in general.

Welding, best methods and best results.

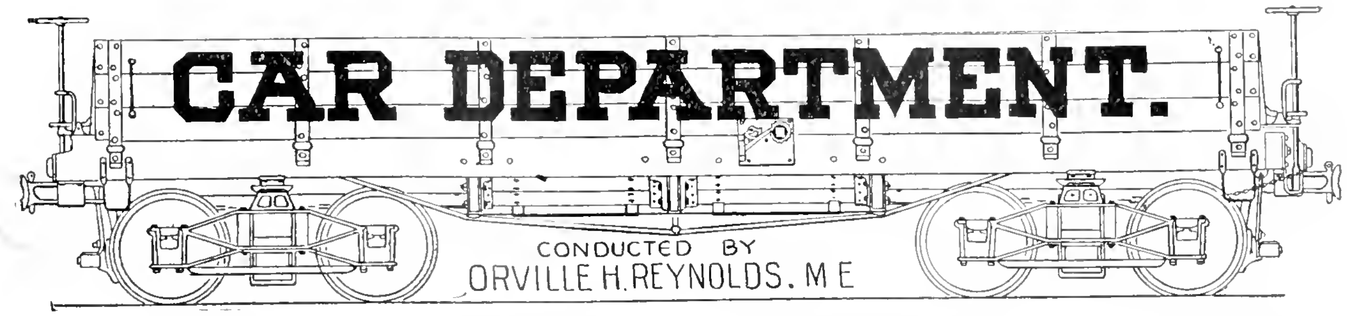
These are certainly good subjects, and ought to call out information of use and value to the members and the railroads that employ them.

There is an article to be seen in the office of Mr. R. C. Blackall, superintendent of machinery of the Delaware & Hudson, that indicates that steel cars would have a short life in some kinds of service. It is a brace taken off the bottom of a coal car which had been in use only about three months. The iron is corroded in some places to half its original thickness. The acids developed from the sulphurets in some kinds of coal is very destructive to iron and steel.

We are in receipt of a very handsome catalogue of the Nicholson File Co., of Providence, R. I. This is the finest piece of work of this kind that has ever come into our office. There is nothing wanting to make it a piece of art in the printing line, and it covers the field of the makers thoroughly. There is only one criticism that can be made on it, and that is its size. It is $11\frac{1}{4} \times 14\frac{1}{4}$ inches. This is larger than any size adopted by the M. C. B. and M. M. associations, and will not go into the standard filing cabinets. Any one interested in files ought to send for this catalogue. It's altogether lovely.

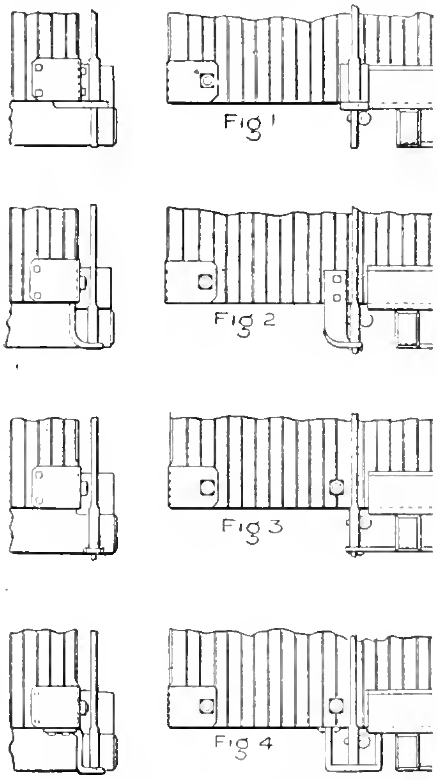
Those who have had any difficulty in making phosphor bronze, may find their trouble comes from the peculiar change which copper undergoes when fluxed with phosphorus. Use black lead chargers for introducing the phosphorus; the results will fully repay all trouble, as the toughness and strength of the metal is wonderfully increased. The Jos. Dixon Crucible Co., of Jersey City, make chargers and other plumbago goods for similar work.

LOCOMOTIVE ENGINEERING was the first railroad paper to adopt the standard size of the M. C. B. Association. It is so much more convenient for everybody, from the publisher to the reader, that we only wonder we did not reduce the size and increase the number of pages long ago.



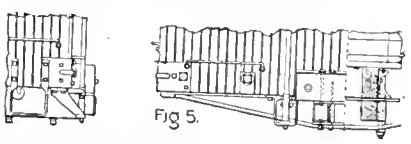
Some Brake-Shaft Rests.

Anyone taking a stroll through a transfer yard, will find himself among an equipment representing sections widely remote from each other. To the student of car anatomy, a walk among these strangers is of the greatest interest, as showing the different practice in construction, how far



apart carmen drift in design to reach a common end or a like result.

This is true not only of one detail, but applies to cars of different builds, from



the running boards down to the sills. In a group of cars noticed not long ago, there were no two of them furnishing evidence of any similarity in the design of their brake-shaft rests, and there was such a glaring want of uniformity, even among cars of the same road, that an observer interested in the matter would at once stop and wonder why this was thus.

As to the condition of some of these, crying for a wrench here, a nut there, loose, bent and distorted, a wreck of their former selves, they were not pleasant things to contemplate. In one case the shaft had usurped the functions of the rest, by holding the latter up, by means of the cutter through shaft and on underside of rest, the roof plate holding up the whole business, by reason of the lag screws working loose in the rest; and this in a train made up and ready to pull out. It was not necessary to read the owner's name on this car to realize that it was away from home, notwithstanding that a corps of efficient inspectors were hustling to get through the yard.

A few hasty sketches took in some of these peculiarities for preservation—a horrible example of inventive genius run mad. Taking them in the order sketched, Fig. 1 is a cast-iron rest supporting the brake staff, which is enlarged near the lower end so as to form a shoulder, below which is a reduced section for brake chain to wind on, and which passes through the rest. The weakness of this arrangement lies in its springy, unsupported end. This was designed as an improvement on the old *unreliables*. It would seem not to have jumped into favor very extensively, as only one example of this was found. Perhaps they are like some children who have no beauty, except in the eyes of fond parents.

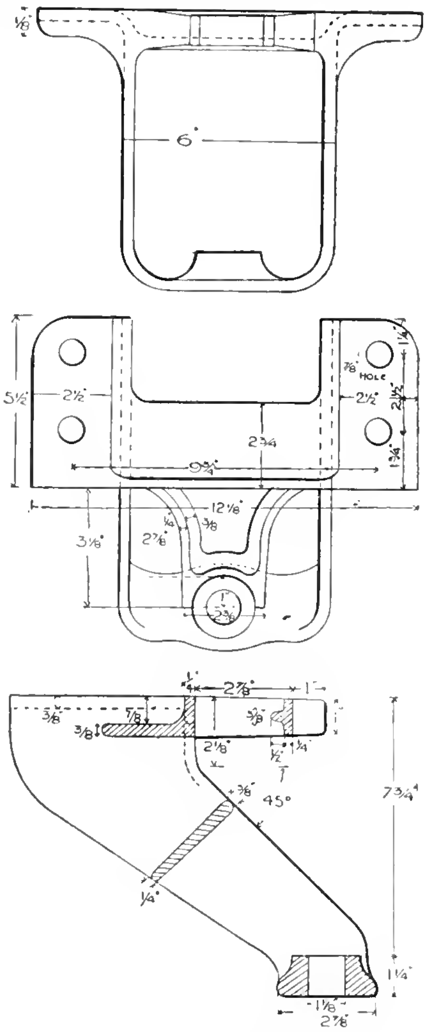
Another aspirant for honors in car construction has given us Fig. 2, a wrought-iron rest supporting the brake shaft in the old orthodox way. This is open to the same criticism as Fig. 1. It was found bent back fully ½ inch at the bottom—just what should be looked for, as the strain is all in the direction of greatest weakness.

Fig. 3 is an old stand-by, commending itself for its simplicity and low first cost, being merely an extension of the carrier iron which supports the drawbar. Here the pull on brake chain is in the direction of the greatest strength, and that there was no weakness in this rest—was plenty strong enough—was attested by the fact that four or five cars from different roads having it showed up without any deflection whatever.

The only feature about this rest to find fault with, was a loosening of the bolts passing through rest and draft timber, and a widening of the grain in the draft timbers at the origin of moment, or fulcrum. This was occasioned, of course, by the strain on the brake chain, and was most apparent on non-air cars.

The wrought-iron rest in Fig. 4 is fair to look upon, but subject to the same fault of taking a permanent set toward the underside of car. Several were found in this condition. This looks like an expensive rest to build, and does not appear to have any special virtues to recommend it.

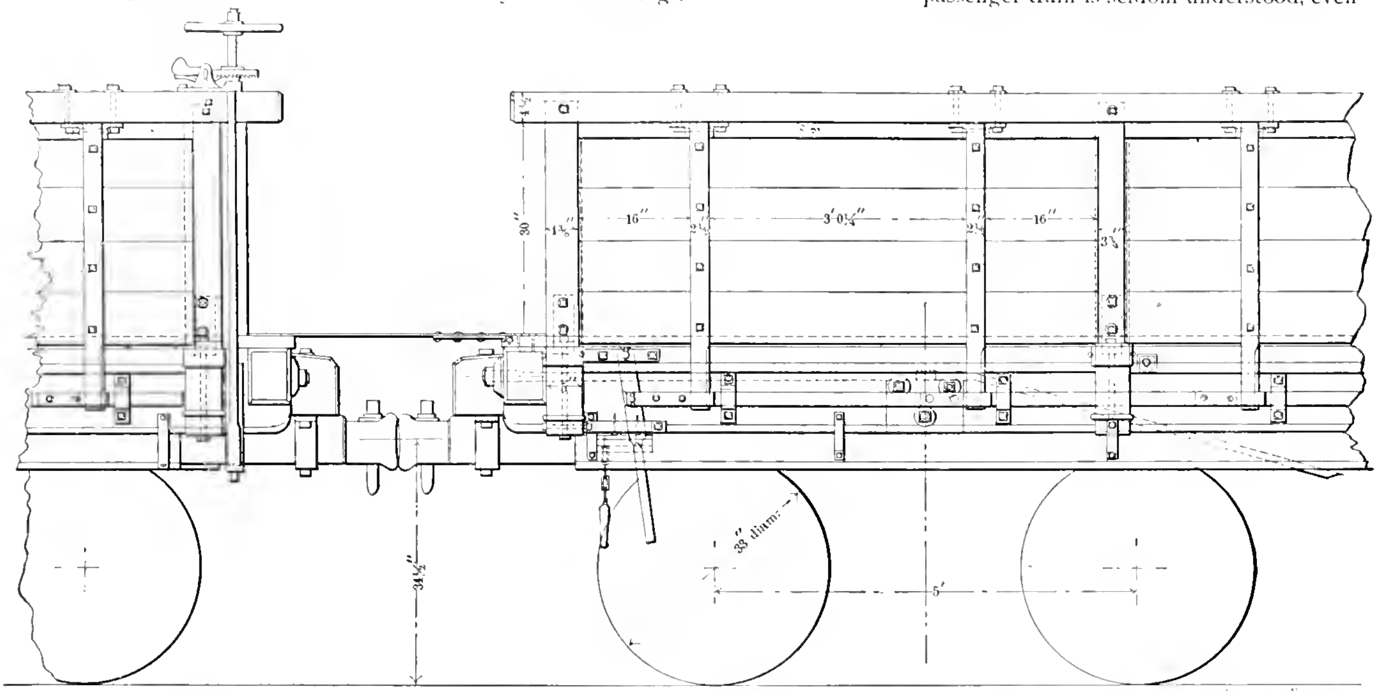
As an example of good practice Fig. 5 is shown, in which mechanical lines are



closely followed, and cheapness in first cost is the ruling idea. Some one has said that "anything that is mechanical is right"; this rest must be right, for it's mechanical, as witness the lug or arm projecting from the top of rest to the brake shaft, forming a bearing for the shaft to receive pull on the brake chain, thus relieving the bottom of brake rest, and in turn the lag screws securing rest to underside of end sill, from the blighting effects of those stresses. It is seen that no bearing

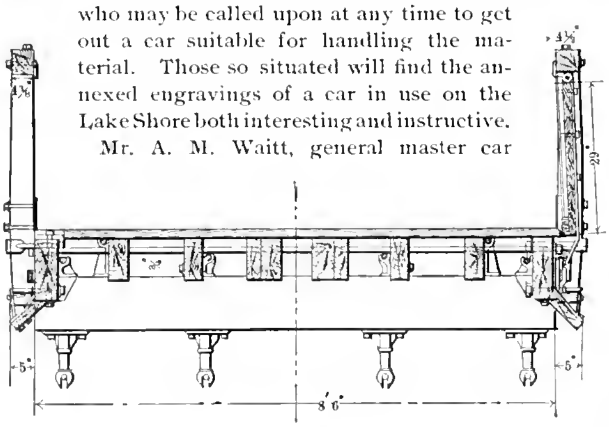
is necessary on the end of car for the brake shaft to rest in when this device is used. The whole thing is self-contained and costs but little money new, and nothing for maintenance. It is designed by Mr. Ed. Passon, chief draughtsman of the Northern Pacific. It is not patented, and for those who see merit in it and think they have got to have it, a special detail for malleable iron is shown in Fig. 6.

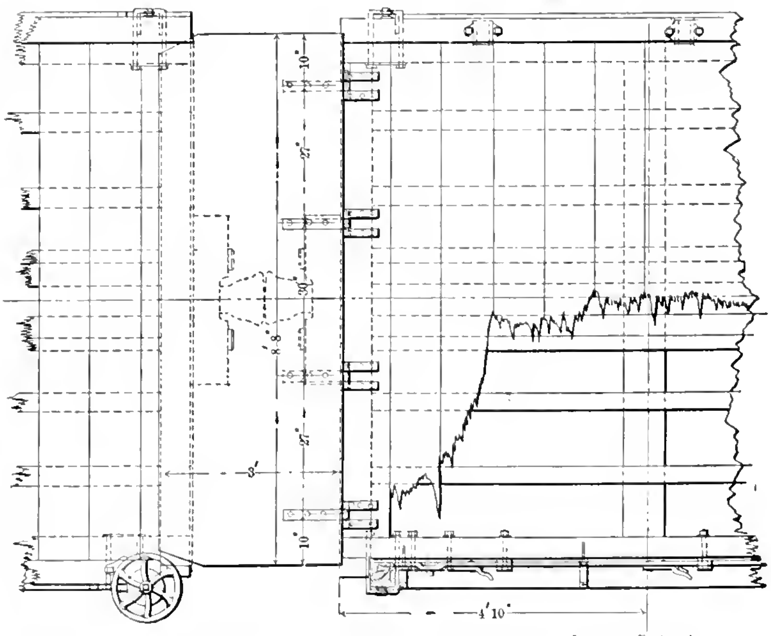
And these are only a few points found at the transfer yard.



Lake Shore Sand Car.

As there will have to be a great deal of track elevating done in cities in the future, there are many master car builders who may be called upon at any time to get out a car suitable for handling the material. Those so situated will find the annexed engravings of a car in use on the Lake Shore both interesting and instructive. Mr. A. M. Waitt, general master car builder, writing to us about the car, says: "I take pleasure in sending you blueprint showing the arrangement of superstructure to 34-foot flat cars used in connection with the track elevation at Chicago, making a side-board car for the carrying of sand, which will permit of the use of a large single-track or double-track sand plow for unloading. A great deal of the design and detail of this arrangement was done by Mr. John Kirby, formerly general master car builder of this company. The arrangement is such that the five swinging doors on each side can be locked or unlocked together by means of the lever located at one end of the car. In order to make a level surface for the plow to run on from one car to the other, hinged sheet-iron aprons are provided between the cars, one on each car. The brake staff is located outside of the frame of the car so as not to interfere in any way with the working of the plow. Forty of these cars were constructed by this company, and the Chicago, Rock Island & Pacific Railway constructed forty to our drawings.





Plating Department in a Railroad Shop.

Anything savoring of mystery has a charm for most people—a charm that lingers even after the light of investigation reveals in its simplicity something we had thought just a little too occult to be easily explained. This was brought forcibly to mind one day, when exploring the shops of one of our prominent roads for points. Finding the foreman of the plating department in his usual happy frame of mind, we were soon following the various processes through which the bright metallic trimmings of coaches, dining cars and sleeping cars passed, while being made "things of beauty" once more, and ready to do duty again in their respective cars, on coming out of the shops.

The immense amount of this bright work entering into the ornamentation of a passenger train is seldom understood, even by the most blasé patrons of these palaces on wheels, simply because they fail to notice the details. Lamps, door locks, hinges, sash locks, berth locks, curtain rods and brackets, screwheads and the omnipresent cuspidor; all these and more, under the generic head of "trimmings," are touched by the wand of this magician, and transformed into furnishings fit for a fairy's home.

The first move to this end is to thoroughly clean all the trimmings by dipping them into a solution of XXX potash—4 pounds of potash to 25 gallons water, contained in an immense cast-iron caldron, and kept hot by connection with the steam-heating system, reminding one ever so much of the witch scene in "Macbeth," with its bubbling and curling vapor.

After dipping in potash bath and rinsing in clean, cold water, the parts are next dipped in an acid bath and rinsed again, this time in hot water, when they are transferred to a long shallow box containing sawdust, and dried.

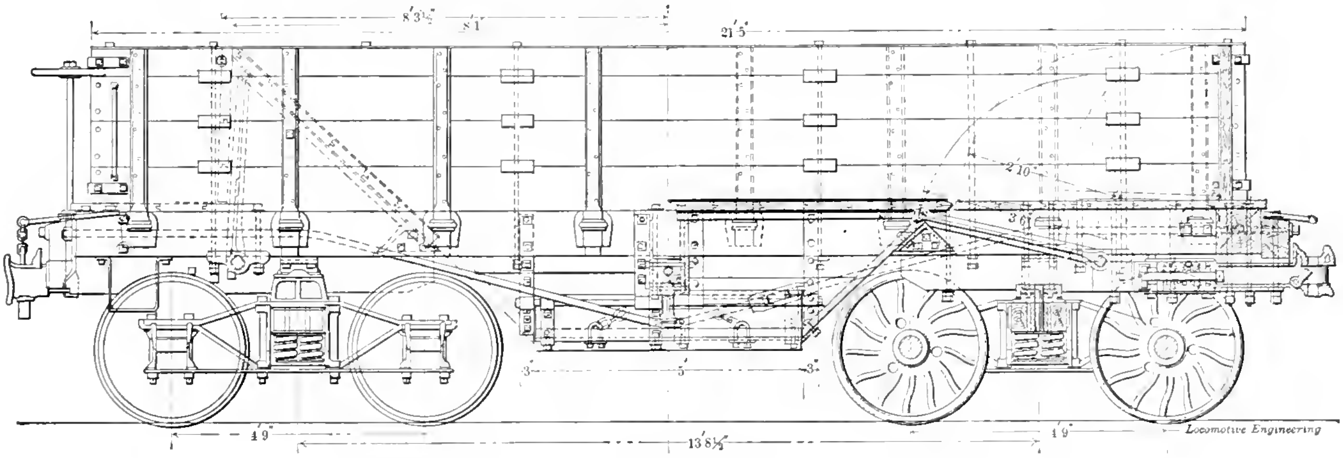
This leaves the metal in a state of absolute purity, so far as the presence of dirt or grease on the surface is concerned; a brightness that would soon take its leave were not the atmosphere excluded by a coat of lacquer or plating.

The lacquer used is known as Lastrina lacquer No. 1. This is applied exclusively with the brush. When lacquering by dipping the work, a lacquer is specially made for the purpose from the following formula: 4 ounces of gum mastic, 3 ounces of seed lac, 1 gallon of alcohol, placed in a bottle and left in a hot water bath about two hours, when it is ready for use.

The work dipped in this lacquer is left uniformly bright and free from streaks.

In silver and nickel plating the article is cleaned by dipping in the potash solution, and rinsing and drying as before. If the work has been plated previously, and shows signs of wear in spots, the process of stripping is resorted to—that is, denuding the work of the old plating, in order to obtain a new plate of constant thickness, which, it is plain, would not be had if a new plate had been put over the old, with its worn or bald spots. The economy attending this operation of stripping is apparent, for all the old plate is saved and used. The bath for stripping is made of 1 gallon of sulphuric acid to 1 ounce of nitric acid. This bath leaves the metal in a much better condition, and is greatly preferable, in its results, to the old process, in which saltpetre is used with sulphuric acid, for the reason that pitting frequently occurred and exposed portions of the metal would be practically eaten up before the plated parts could be attacked by the stripping solution. The first mentioned stripper will not harm the metal in worn places, therefore does not need skillful attendance.

The work is next taken to the buffing wheels, not for final polishing, but to get the metal as smooth as possible for the striking process. These wheels are made of bleached cotton, cut in circular form roughly, about 8 inches in diameter, laid together, making a disc about 2 inches thick, through which the arbor of buffing machine passes; the whole secured on the arbor by a flange on either side in the usual manner—one wheel at each end of arbor. Crocus powder is the polishing medium, gotten out mixed with tallow into cakes or sticks for convenience in handling in application to the wheels, and also to prevent filling the room with its impalpable dust, to the discomfort of the men, as it would if used as a powder.



COMBINED ORE, GONDOLA AND FLAT CAR.

It is the practice in many plating establishments to use a canvas buff, made exactly similar to those described, but necessarily of heavier character, to rough polish with, and finish with the cotton buff; it being one of the traditions of the business that it is necessary to the success of the work. It was found that, owing to the unyielding nature of the canvas, it would make deep scratches (a Buffalo finish, as it were) in work like hinges, or anything with perforations having sharp edges like screw holes. These blemishes were not easy to efface, and the canvas wheel was abandoned.

A treatment in the striking solution referred to above, follows the stripping and buffing. Striking is understood among the craft as preparing the material to receive its plate. This is said to be one of the vital operations connected with the art of plating, for without proper care in the preparatory stages the success in this is purely speculative. The name of this process is strictly a trade term; meaningless, perhaps, to the layman, but full of import to the esthetic gentleman who has his shelves full of erstwhile bright work waiting to be overhauled. Its function is to leave the metal that is to be plated in such a condition that it will have an affinity for the plate, causing it to adhere to every portion of the surface closer than the proverbial brother, thus preventing all liability of blistering or peeling while in the hands of polishers and burnishers.

The baths for silver, nickel and copper, respectively, are arranged with reference to hustling the work, for that is the all-important consideration in this small but very efficient plant.

After striking, the material is suspended in the plating bath, completely submerged, and the dynamo does the rest. If the object to be plated is of iron or the baser metals, it is first given a plate of copper, after the cleansing process described for the other metals, and on this copper base the finer plate is deposited.

The eight-volt dynamo that furnishes the push for the subtle fluid so faithfully performing its mysterious mission, is revolving ten hours per day every working day in the month, wired to all the plating baths, with switches and cut-outs.

The time required in the electric bath for a triple plate of silver is three and one-half hours. A heavy plate of nickel is deposited in about twenty minutes—the time element governing in all cases. After receiving the plate, the articles go to the buffers and burnishers. The plain circular shapes, like lamp columns and bodies, cuspidors and curtain rods, are burnished in the lathe—the more intricate shapes being handled by the slower hand process.

To the uninitiated it looks like an interminable job to see the artist moving his polished steel hand tool over the dull white surface, to produce its beautiful sheen, but a few minutes' observation will show satisfactory progress in square inches of finish.

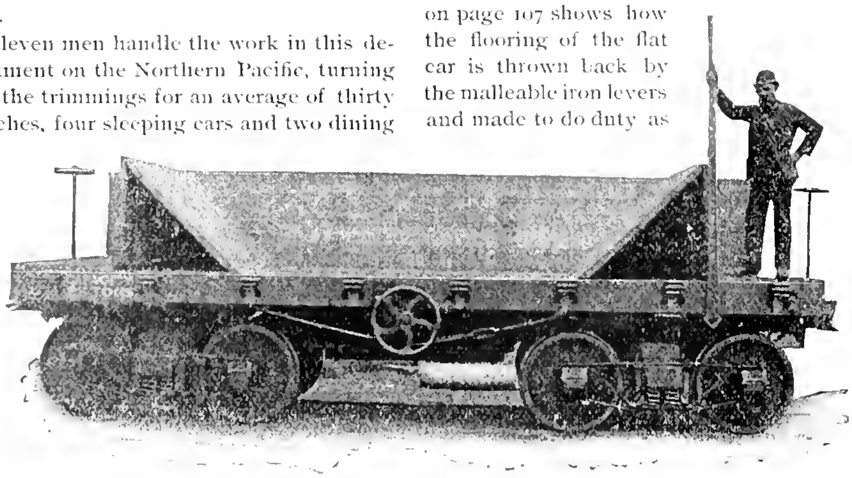
The satin finish on silver is chiefly on the table service of diners, knife and fork handles, wine coolers, chafing dishes, and the like.

An 18-inch square box of No. 20 iron, in connection with compressed-air system, and a supply of fine white sand, comprise the facilities for making this lack-lustre surface, always so much admired.

This process with sand is very much like that in the production of the ground

figures on glass, in which those parts that are not to appear dulled are protected from the action of the sand-blast; for that is the method of doing this work, the sand being forced against the work by air pressure, throttled to any degree of intensity.

Eleven men handle the work in this department on the Northern Pacific, turning out the trimmings for an average of thirty coaches, four sleeping cars and two dining cars per month, besides replating locomotive headlight reflectors and other miscellaneous work on shop orders.



Both Ends in Position for Ore Service.

When the shelves are laden with work newly finished, ready to be returned to their former places in the cars, these rooms resemble an art exhibit more than a plating department in a railroad shop.

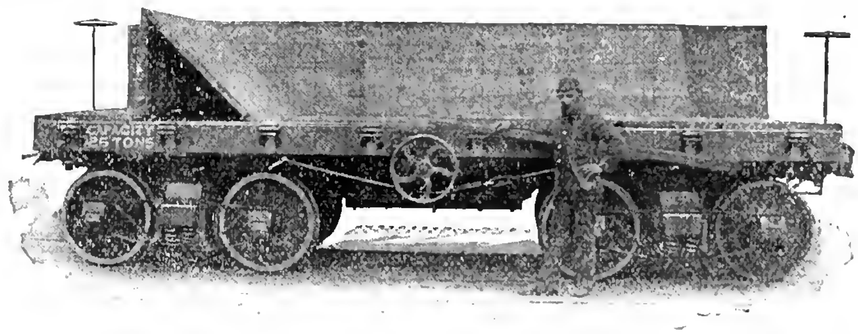
The genial foreman, Mr. George Govin, installed this department some seven years ago. Through his intelligent administration of affairs, it has been brought to the forefront of like establishments, whether in railroad or trade circles. The courtesy of this gentleman has left pleasant recollections in many quarters; there are no trade secrets hidebound in his generous proportions.

Combination Ore, Gondola and Flat Car.

Master Car Builder Mulvihill and Master Mechanic Connolly, of the D., S. S. & A., have designed and built some convertible cars for ore-carrying that seem to be a desirable improvement. This road has a very large iron ore business in the summer months; in the winter, ore cars lie idle. In order to get a car that could be used for hauling coal, lumber logs or other freight, as well as ore, the design here shown was perfected.

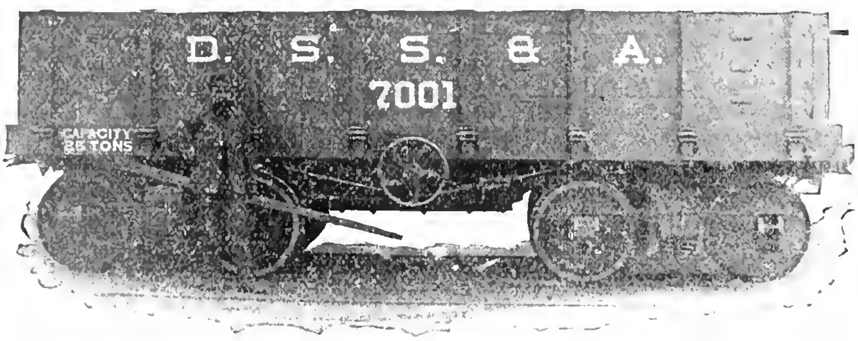
In the first place, they were restricted as to length of car, owing to the length of pockets on the great ore docks—the car could only be 22 feet long over all.

Our engravings will make the construction of this car plain. The detail drawing on page 107 shows how the flooring of the flat car is thrown back by the malleable iron levers and made to do duty as the inclined ends of the ore car. The car carries from 25 to 27 tons of soft ore, and from 30 to 32 tons of hard ore. Fitted as a gondola, it will carry 14,000 feet of lumber or 14 tons of coal.



One Side Removed and One End Inclined.

The dump is operated from the side, and handles very easily, as the 2-inch chain shaft is protected by a box formed of two angle irons, so that there is no pressure on it.



Ready for Ore Service.

The car is easily changed from ore dump to gondola by means of the long wrench shown in the hands of the manipulator. This is done at very little expense. The road has had twenty-five of these cars in service for the past year or more, and they are pronounced a success by everybody handling them. The designers have recently taken out a patent on the device.

The Consolidated Car Heating Co., Albany, N. Y., have been very busy in their shops all this season with the fitting-up of steam and electric heaters. The latter have been greatly in demand, and are becoming highly popular with electric railway companies. The heater is remarkably simple, consisting of spirally-twisted wire coiled round a porcelain arbor. They have a remarkably ingenious and efficient switch for regulating and controlling the electric current, so that the heater is regulated to suit the weather. The switch is so designed that mistakes cannot be made by those operating it. The shops of the company are remarkably well equipped with special tools adapted for turning out the work accurately and expeditiously. When a new article has to be manufactured, the first consideration is to make tools that will reduce the cost of production to a minimum. In Mr. McElroy, the mechanical expert, they have a man highly fertile as an inventor, and everything which he designs seems to be of a highly practical character.

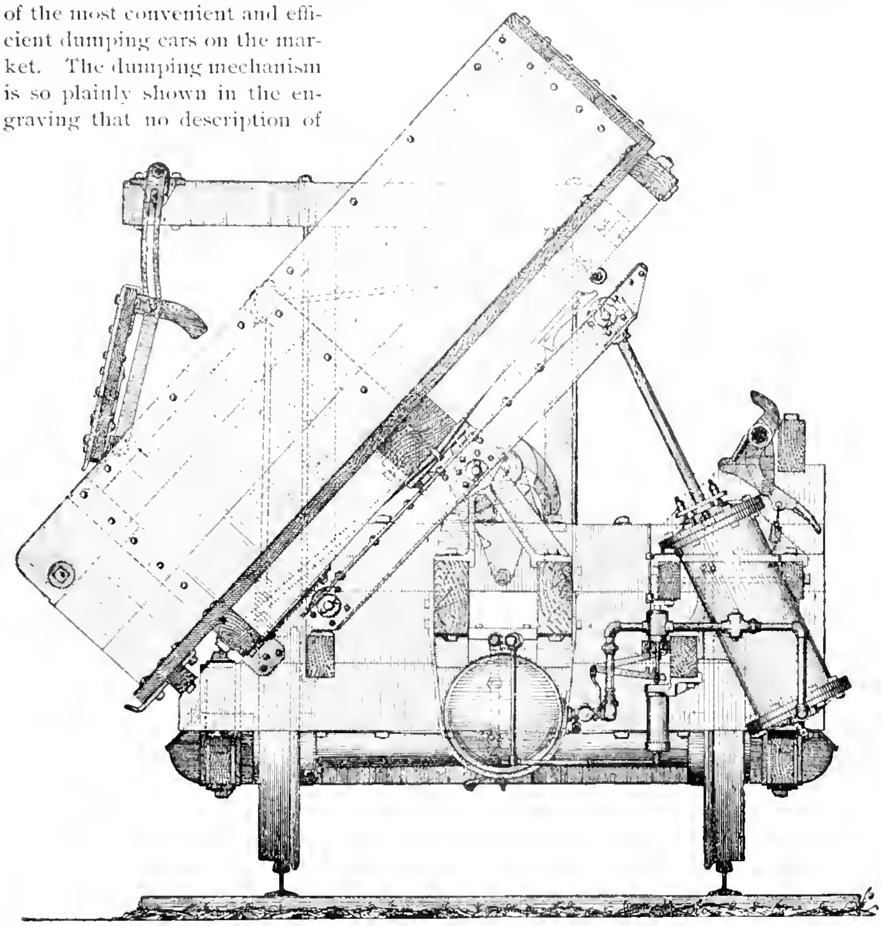
A circular has been issued by a committee of the Railway Master Mechanics' Association, calling for information on the utilization of railroad scrap material. The hard times have required so many men to use up the scrap heap, that there must be a great deal of information on the subject quite fresh and up to date. Those who have been acquiring experience in working up scrap should send all the facts to H. P. Robinson, *Railway Age*, Monadnock Building, Chicago, Ill.

The number of lives lost by trolley cars in Brooklyn and other Eastern cities is cultivating a sentiment in favor of abolishing the statutory limit of $5,000 as the value of a human life. The average American citizen's life is worth more than $5,000 to his wife and children, and it is a mockery of justice to prevent them by law from collecting what their bread-winner was worth.

The new Niagara Falls plant of the Pittsburgh Reduction Company, manufacturers of aluminum, is nearing completion, and the company report increasing business.

Tripp's Air-Operated Dumping Car.

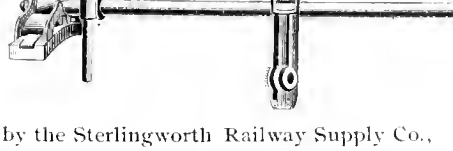
The annexed engraving shows Tripp's air-operated dumping car, which is one of the most convenient and efficient dumping cars on the market. The dumping mechanism is so plainly shown in the engraving that no description of



that is necessary. The aim of the designer has been to combine simplicity and durability with economy of the air required for operating the cars. This has been worked out so skillfully that the standard air drum on the locomotive is of sufficient capacity to hold air for operating the dumping mechanism of all the cars an engine can haul. The car is suitable for handling any kind of freight which is not damaged by dumping, and the work is done very expeditiously, for it is not necessary to stop the train while the unloading is going on. The car is made and put upon the market by the Gates Iron Works, 50 South Clinton street, South Chicago, which will furnish full particulars to persons interested.

Two New Brake Beams.

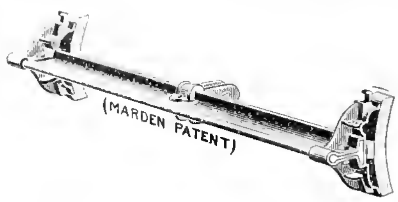
We illustrate herewith two new metal brake beams recently placed on the market



by the Sterlingworth Railway Supply Co., of this city.

The Marden beam is well known; this, however, is a new form with entirely new heads. It has the fewest parts of any brake beam, is perfectly balanced, and occupies less room than a trussed beam.

The Player beam is a built-up beam, the arch being formed of pipe, which bears a compressing strain only; the truss rod is



straight. This beam has been in severe service for three or four years on about ten thousand cars on the A., T. & S. F. road.

Stannard & White, of Appleton Wis., have sent out illustrated circulars showing the various articles they handle, most of them being for locomotive purposes. Their Brotherhood seat, which is so well known, is lavishly illustrated. Besides that, they are handling a seat-box lock, for which valuable claims are made. Their water-glass cutter, which became so suddenly popular, is also illustrated, and another very useful tool is shown, namely, a universal washer cutter. Besides this, there is a poem by Shandy Maguire on the Brotherhood seat, and a lifelike portrait of the author.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(15) W. H. P., Reading, Pa., asks:

What is the first thing that moves when an engine is given steam? *A.*—The piston.

(16) G. B. R., Bode, Ia., asks:

Why is firebox steel but $\frac{5}{16}$ to $\frac{3}{8}$ of an inch thick? Would not $\frac{1}{2}$-inch steel stand and hold staybolts better? *A.*—The thinner the steel the better it will conduct heat; thicker sheets blister on the fire side.

(17) G. F. S., Waltham, Mass., asks:

1. What is the primary object for making, in the tops of cabs, openings covered by hinged covers? 2. What, if any, are secondary uses to which these openings are put? *A.*—So far as we know, they are used solely for ventilation.

(18) Ed. F. L., E. Wilton, N. H., asks:

Why is the lower rocker arm set back of the center, as it is on most builds of locomotives? *A.*—To bring lower arm of rocker at right angles to the center line of motion of the valve gear, or a line drawn from center of axle to center of lower pin in rocker arm.

(19) W. W., Stuart, Ia., asks:

What is meant by the mechanical term horse-power. *A.*—It is 33,000 pounds raised 1 foot per minute, or its equivalent, such as 330 pounds raised 100 feet per minute. It is a unit used for measuring the amount of work done by steam engines and other machines.

(20) H. C. C., Stillwater, Minn., asks:

If it were necessary to take down the side rods of a mogul where the pin on the forward drivers would not clear the crosshead key, how could the engine be run in? *A.*—Block the crosshead in the center of the guides, and the pin will *go around* the key, and not touch it.

(21) W. H. W., Chicago, writes:

If a reservoir, of U. S. standard gallon capacity, be filled with water, and a pressure of 100 pounds pumped on, how much water over one gallon would reservoir contain at that pressure? Also, give rule for finding same. *A.*—It would not hold any more, because water is practically incompressible.

(22) H. E. M., Monson, Me., asks:

Would it be possible for an electric railroad to haul ordinary freight cars and do a freight business with electricity as a motive power? *A.*—Yes; but it would be very expensive. Electricity as applied to motor cars is nothing more than a belt or shaft, it is simply a means of conveying power from a steam engine to the cars.

(23) W. F. T., Philadelphia, Pa., writes:

What are the advantages claimed for the Belpaire boiler over the straight boiler? *A.*—Increase of strength. Two other questions are asked by this correspondent which are not suited for these columns. Questions to be suitable should be of general interest, and they should not require us to express views on the merits of articles of rival manufacturers.

(24) J. C., Brooklyn, N. Y., asks:

1. Does stature enter into the requirements of a job of firing? I am told it does; I am 5 feet 6 inches. *A.*—No. 2. You mention valves as having $\frac{7}{64}$ lead on one side and $\frac{10}{64}$ on the other; does this mean on the same valve or on the opposite sides of engine? Why? *A.*—On the same valve. This is often done to equalize the cut-off, owing to angularity of main rod or other causes.

(25) L. W. R., Newton, Kans., writes:

When copper and tin are soldered to-

gether, as in a common tin washing boiler with a copper bottom, will the copper eat or burn the tin where they are joined? *A.*—Under certain circumstances, a galvanic action will set up between the copper and the iron of the tin plate. This will eat away the joint. The other question asked will be answered next month by an article on blocks and pulleys.

(26) N. S., Moncton, N. B., says:

We have had some discussion here about brakes, and decided to refer a dispute to you. Suppose there were only four cars with hand brakes on a train of twenty-five cars, two of them behind and two of them in front. One side says the cars behind will be more effective than those in front; the other side says it would be the opposite way. What do you say? *A.*—There would be no difference due to the location of the cars.

(27) W. J., Groveton, Tex., writes:

1. I claim that the crank of a steam engine travels six times as far as the piston while on the first inch of the stroke. 2. While making the middle inch, it moves a little more than twice as far; my friend says it does not. Who is right? *A.*—Your friend. Suppose your engine had 1-inch stroke, where would you be? You should get Locomotive Engineering Educational Chart No. 1, 1894. It will make the angularity of the rod plain to you.

(28) W. S., Luneburg, N. Y., writes:

1. Please give rule for finding strength of bolts, say 1¼ x 20 inches. *A.*—Multiply the area of the cross section of the bolt in inches by the tensile strength of the iron, say 40,000 pounds. The product will be the total strength of the bolt. One-fourth of this is considered the safe working strength. 2. Is tractive force of an engine equal to the pull on the drawbar? *A.*—It is the pull on the drawbar, less the internal friction of the engine.

(29) E. G. McK., Walnut Springs, Tex., asks:

Do the driving boxes move up and down between the pedestals, or do the frame, boiler and all move up and down over or by the driving boxes? *A.*—The driving boxes usually move along at a fixed distance above the rail, and the frames, with everything resting upon them, move up and down as stirred by inequalities of the track; a quick movement of the wheel may move itself up in the box, however.

(30) N. M., Kalispell, Mont., writes:

How should I block up a consolidation engine with a broken No. 3 driving spring? How should I put in a block to hold the side that is disabled, as high as opposite side. The driving wheels are built very close between the hub and rim, and besides, the space on top of box is very small *A.*—The only way is to block what is possible over the box, and block up ends of equalizers so as to relieve that box of as much load as possible, putting it on the other axles.

(31) A. S., Ft. Wayne, Ind., asks:

I am running a straight stack and extension front engine, and have a fireman that likes to keep her clean, but he cannot get anything that will stay on the front end, as it burns off. Please tell us, through your paper, what would be a good thing to black it with. *A.*—Clean the front and stack. Go over it with boiled oil when it is only slightly warm. Then rub it well with graphite (black lead), mixed to a thick paste with strong soapsuds. This will take a high polish and stay that way a long time.

(32) W. J. S., North Platte, Neb., writes:

Have been requested to ask you if you can explain why eccentrics wear most at the smallest part, that is, the part nearest the axle. *A.*—The eccentric will wear most at the point where the greatest amount of work is put upon it. The strains on the valve connections are greatest when the valve is changing its motion. This ought to wear the full part and the thin part of the eccentric most, but there may be special causes in the engines referred to for making the wear on the thin part greatest.

(33) O. W. M., Des Moines, Ia., writes:

Please inform me of the greatest piston speed on record. Mr. Charles T. Porter has been complimented on operating an engine successfully with a piston speed of 1,400 feet per minute. At 100 miles an hour the "999" would make 1,586 feet per minute. Has that been exceeded? *A.*—We do not know of any engine being regularly operated at a piston speed greater than 1,400 feet per minute. Locomotives sometimes exceed that for short spurts. The highest piston speed is made by engines with small driving wheels.

(34) Briton, Scranton, Pa., writes:

We have had a little dispute about who first used slide valves with lap. I say the honor of that early improvement belonged to George Stephenson, the man who invented the locomotive. I have often heard it said that the locomotive came out complete from the hands of its inventor, and it could not have been complete without valve lap. *A.*—George Stephenson did not invent the use of lap on slide valves any more than he invented the locomotive, which latter is a popular fallacy spread as gospel by Smiles' romances—"The Lives of the Engineers." American engineers were the first to adopt the use of valve lap, but it is a little uncertain who first applied that important improvement.

(35) J. B., Edgefield, Pa., asks:

1. Is John Alexander still living? *A.*—Yes; very much so. 2. Can the rotary valve seat in plate D 8, W. A. B. engineer's valve, be faced true by a disc of iron or wood, with a true surface, having a sheet of emery cloth on it? *A.*—It might, but the tendency would be for the outside of the plug and seat to wear away most under the action of the emery—more movement over them. 3. Can one tell to a certainty how much water any injector is throwing, without the use of measuring instruments? *A.*—No. 4. Is the Mason or Lansberg brake used anywhere, and are they automatic? *A.*—We know of no Mason brake (there is a Mason air signal); the Lansberg is automatic, used very little.

(36) A. J. B., Batesville, Mo., writes:

Two engines, same size and power; one has five cars and makes thirty miles an hour, the other ten cars and makes fifteen miles an hour (cars same size and weight)—which will take the most fuel, and why? *A.*—The engine running thirty miles an hour will use more coal, for two reasons. First, there will be more power required, owing to the increased resistances of the higher speed, and, second, because there is more dead weight of engine and tender to move in proportion to the train. It might be, however, that the engine was of such power and proportions that she would do the work more economically when running thirty miles an hour than at half the speed. In that case the gain might be on the side of the fast run.

(37) J. W. H., Paducah, Ky., writes:

Please explain inside lap and tell if you think a locomotive is better with or without it. Give full particulars. *A.*—Inside lap is the inside edges of the valve cavity which extends upon the bridge when the valve is set on the middle of the seat. If the cavity is wide enough to extend over both the bridges there is no inside lap. The effect of inside lap is to delay the release of the steam and to advance the point where compression begins. With locomotives that work with low piston speed, inside lap is generally an advantage. When the piston speed is high, inside lap is, as a rule, objectionable, because it causes too much back pressure and compression. The valve motion of a high-speed locomotive may, however, be so designed that inside lap is beneficial.

(38) A. H. R., Osawatomie, Kan., writes:

1. What was the object of using inclined cylinders? *A.*—To keep the cylinders clear of the truck wheels. With inside cylinders it is sometimes done to make the main rod clear the front driving axle. 2. Give me a method to determine the length of rocker arms and throw of eccentrics for a required travel. *A.*—The answer would take too much space on this page. You will find full particulars in the chapter on laying out link motion, in Sinclair's "Locomotive Engine-Running," or in Auchincloss on "Link and Valve Motions." 3. Give me a good recipe for case-hardening. *A.*—The best method for case-hardening is to place the articles in an air-tight iron box among animal charcoal, composed of burnt hoofs, leather, bones, horns, etc., well pulverized. Put this box in a furnace and keep it at a red heat. The time it has to be kept in the furnace will depend upon the size of the articles to be case-hardened.

(39) R. S., Monroe, La.:

Wishes us to put a cut in the paper showing how inside lap should be measured. He says that he has laid out a great many valves for locomotives, and that when he wants an engine to have $\frac{1}{16}$-inch inside lap, he makes the cavity of the valve $\frac{1}{16}$-inch narrow, making it lap on the bridge $\frac{1}{32}$-inch on each side. He also sends a sketch of valve and seat, wherein the cavity is 4⅝ inches wide and the seat between edges of steam ports measures 4⅞ inches. He holds that in this case the valve has ⅞-inch outside lap, while a brother mechanic says the valves are line and line inside. *A.*—A cut is not necessary to show how inside lap is measured. The length that the edge of the valve cavity extends over the bridges when the valve is on the center of the seat, is the amount of inside lap. The valve first mentioned by our correspondent has $\frac{1}{32}$-inch inside lap; the latter has ⅛-inch inside lap. No data are given to tell what the outside lap might be.

(40) R. E. A., New Ramilche, Wash., asks:

How does an engineer find the dead center? *A.* For ordinary purposes on the road, such as disconnecting, the engine may be placed on the dead center by the eye. To get the exact dead center for setting valves, move the engine until crosshead is within a few inches of the end of stroke; mark a line across crosshead and guides; tram from the frame or valve yoke to a point on the tire of main wheel, and make a mark there. Then move engine ahead (for forward center) past the center and until the mark on crosshead *passes* the mark on guides, then back toward center until mark on guides and crossheads coincide. Then tram to wheel again from same point on frame, and make a mark. Then divide the distance between these two marks on tire, and move engine until tram points to the center mark on tire. Engine is then on dead center for that end. Do the same for back end, and repeat for other side. Let machinists do this, if

there are any on the road. It requires care, some degree of skill and experience.

(41) J. W. H., Springfield, Mo., writes: In a book on the locomotive the question is asked: "Suppose the admission is too soon on both strokes, which eccentric will that show to have slipped?" The answer is, "The forward one, and *vice versa*." Is that right? *A.*—The answer given is very vague, and would not help a man much in identifying which eccentric had slipped. The admission might be too late, and yet be caused by the forward eccentric having slipped backward. The way to test which eccentric has slipped is to put the engine in full gear forward, open the cylinder cocks, and use a little steam. The forward cylinder cocks should show steam when the crank-pin is moving below the center, and the back cylinder cock should blow when the pin is moving above the center. If steam escapes in a way that proves it to be entering at the beginning of each stroke, the other side should be tried in the same manner. If the forward gear admission is all right, the back gear can be tested by putting the reverse lever in back motion and watching the time at which steam escapes from the cylinder cocks.

The Richmond Locomotive Works.

Some five years ago, when the Master Mechanics' Convention met at Old Point Comfort, a large party of the members went by special train to Richmond, the principal purpose being to look over the Richmond Locomotive Works, which had just begun to build locomotives. The writer was present and listened attentively to the remarks made by the visitors. They were naturally inclined to look upon everything with friendly regard, but the comments were by no means gratifying. They praised various things shown them, but the sum of the opinions expressed was that these were remarkably good shops *for the South*, and that the work turned out was highly creditable *for a Southern shop*. It seemed to be a settled conviction that nothing in the nature of a mechanical industry in the South could be first-class. If these same people would visit the Richmond Locomotive Works to-day they would be constrained to admit that the works and their product now compare favorably with anything to be found anywhere. The shops are as well equipped with first-class machinery, their system of working is as well organized and their locomotives turned out are as good as anything seen in the best of our Northern shops, and in every respect better than some of them. Those who build locomotives for sale may as well understand that a Southern establishment is now prepared to do work, without fear or favor, in competition with the best-equipped and best-managed shops in the North.

The writer spent a couple of days in the Richmond Locomotive Works last month, and most of the time was devoted to watching the methods of working and to examining the tools provided for doing the work. The methods and the tools are about the same as those I have been familiar with in the course of numerous visits to the best Northern locomotive building establishments. In some respects the condition of the working forces in the Richmond shops is surprising, for they have been organized and developed from crude material. Those who are familiar with the manufacture of locomotives know that the subdivision of labor and piece work have been carried out to the fullest extent. The older shops have been working up the piece-work system gradually for years, they have been located where select mechanics could readily be found, and good, industrious workmen learned by experience that they could make good wages under the piece-work system. Starting up a system of that kind at once was a most difficult operation. Its difficulties were very well appreciated in the Grant Locomotive Works in Chicago, a city where plenty of mechanics could be hired. That enterprise failed in a great measure because the skilled help would not agree to do work as it is done in other locomotive building works.

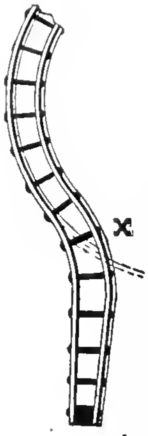
It is particularly to the credit of the men in charge of the Richmond Locomotive Works that they were able to organize and put into successful operation the manufacturing system in a city where skilled mechanics are not over abundant.

Within the last two years the proprietors of these works have put in over $150,000 worth of new tools. These were not to replace worn-out or antiquated machines, but were additions considered necessary to do the work properly and expeditiously. This firm built the engines and boilers for the battleship *Texas*, which made the purchase of certain heavy tools necessary for the machine shop and boiler shop. These are now very useful on locomotive work.

The capacity of the different shops appears to be very well balanced for the manufacture of from 200 to 250 locomotives a year. The blacksmith shop and the boiler shop are particularly well provided with labor-saving tools. There is an excellent hydraulic plant in the boiler shop, which is skillfully operated. From the examples of boiler making which I examined in that shop, I should conclude that the boilers supplying steam to Richmond locomotives would be little troubled with the many ills high-pressure boilers are heir to.

These works have been fairly busy during the season of depression, but they are rather slack now. They have just completed the building of some fine six-wheel switchers for the Southern Railway, and are now working on a variety of small engines for mines and furnaces. The men in charge are taking advantage of the lull in business to make a variety of improvements in the works which will put them in a position to rush things when the demand for locomotives becomes active, which is certain to happen soon. A. S.

We will extend any subscription three months or pay 40 cents, cash, for each clean copy of January, 1894.



Where Do Side Sheets Bulge Most?

The committee of the Master Mechanics' Association delegated to hunt up the causes of bulging of firebox sheets, are anxious to know if any one has noticed more of a tendency of side sheets to bulge below the point marked X than above it. Send answers to Pulaski Leeds, Supt. M. P., L. & N., Louisville, Ky.

Would Do As Well As the Best of Them.

"Well," said the superintendent to the applicant for a job as trainman, "I don't know as we want any freight brakesmen or conductors, but, by the great American eagle, we do want some new passenger conductors—did you ever run a passenger train?"

"Oh, yes."

"Well, now, confidentially, if I should give you a passenger train right off, what percentage of the cash receipts would you be willing to turn in to the company?"

"Why, whatever is usual; what do the rest turn in?"

"Nothing—not a red cent!"

"Well, if that's the rule on the road it's perfectly satisfactory to me."

Steamboat designers appear to be doing more to increase the speed of vessels than what locomotive designers are doing to increase the speed of locomotives. With all the talk about the fast speed made on American railways during the last few years, the locomotives have increased in velocity very little over those of forty years ago. It is altogether different with steamers. Forty years ago there were very few steamers that could make a speed of 15 miles an hour, and now we learn that a torpedo boat recently built for the British Admiralty has steamed at the rate of 33½ miles an hour, the fastest velocity ever attained by a steam vessel. The boat is 200 feet long, 19 feet wide and 14 feet deep. The engines are 5,000 horse-power.

The New England Railroad Club have passed a formal resolution indorsing the proposed changes in the Master Car Builders' rules of interchange of cars, to make owners responsible for the repairs of their own cars when the necessity for repairs has not arisen through an accident.

Mr. W. E. Farley, Conneaut, Ohio, wishes to obtain a June, 1892, number of LOCOMOTIVE ENGINEERING. Any one wishing to dispose of that issue, please address him.

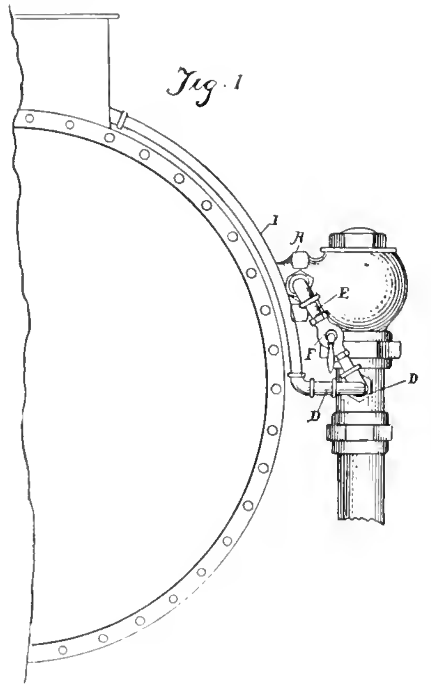
An Improved Feed-Pipe Heater for Locomotives.

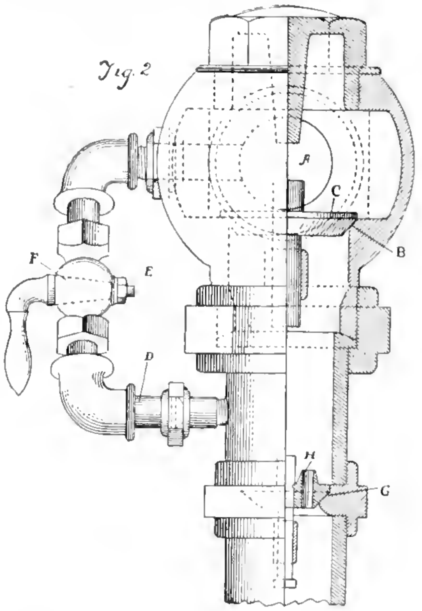
On the Hannibal & St. Joseph road they are testing a new design of feed-pipe heater designed by Jas. C. Shaw, an engineer on the above road.

He provides a controlled connection between the water or steam space in the boiler and the under side of the check, as shown in Fig. 2.

This can be set and left with heater on, any length of time, as it does not interfere with the working of pump or non-lifting injector. Where the line check is in pipe and not in injector, an opening is made in it, as shown at *H*, Fig. 2, to allow steam to heat pipe behind it.

Fig. 1 shows a similar device, except that a live steam pipe is connected to it and carried back to cab, where engineer can stop or start heater, it having been found that with some lifting injectors this was necessary.





FEED-PIPE HEATER.

This device keeps pipes from freezing, without attention from engineer, does not waste steam, and prevents cutting-out of valves and seats of injector valves by using as heaters. It worked well last winter on several engines and seems to have demonstrated its usefulness.

We have received a handsome illustrated catalogue of the switch and signal department of the Eclipse Co., Beaver Falls, Pa. The semaphore, interlocking switches, etc., are manufactured and operated under the Abernethy patents. The claims made for the devices manufactured will be readily understood from a series of colored catch headings to the pages of the catalogue. These say: The Eclipse will pay for itself in ninety days. Mistakes cannot occur. Works automatically and is always to be relied upon. Gives an unmistakable caution signal to trains. The capacity of a road greatly increased by using the Eclipse semaphore. No rear-end collisions. No greater contrast possible between danger and safety positions. Operators cannot move the blade out of danger without causing an alarm bell to ring. No more running into open switches.

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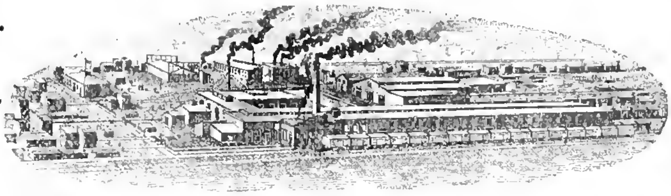

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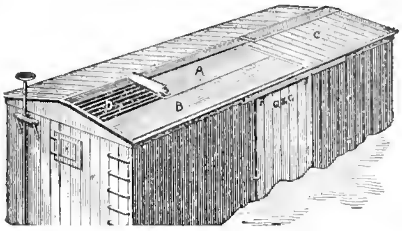

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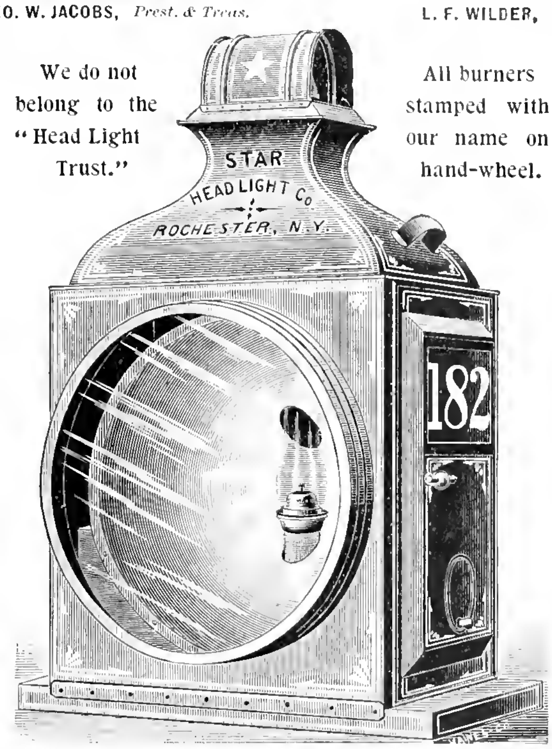

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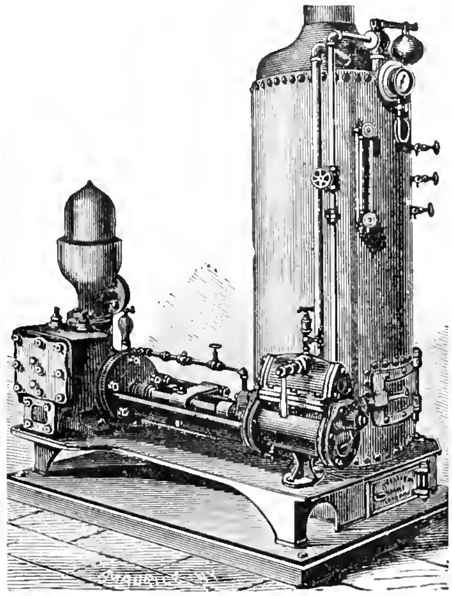

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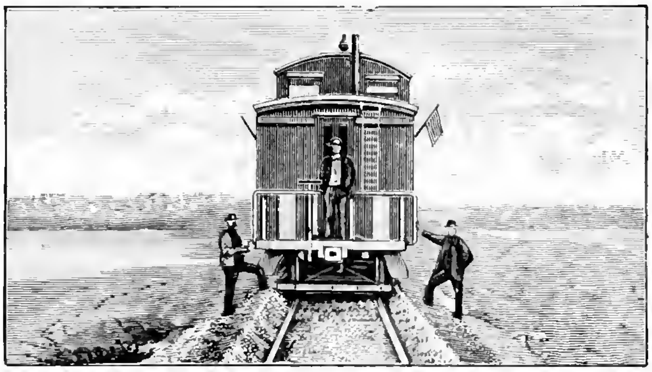

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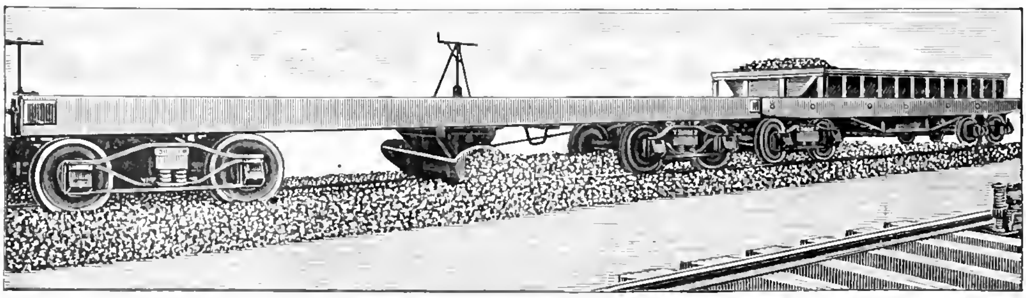

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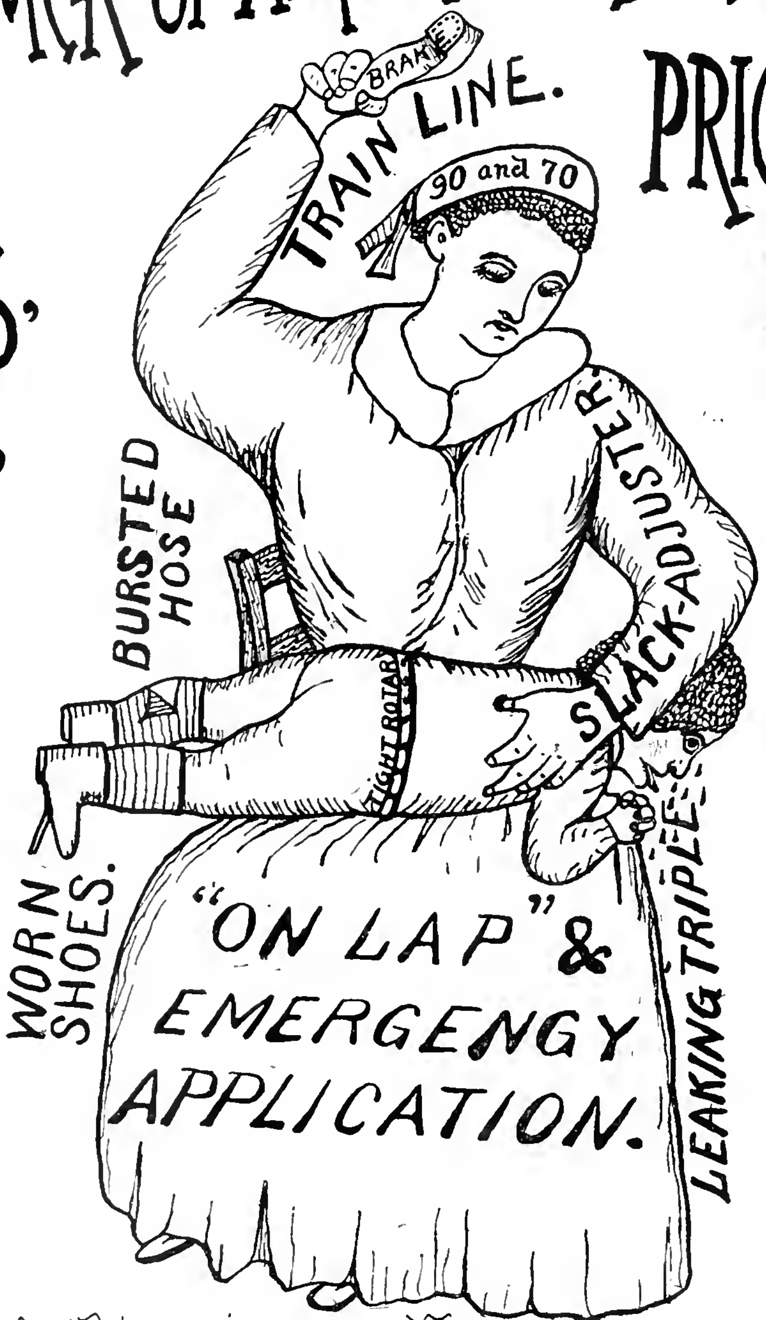

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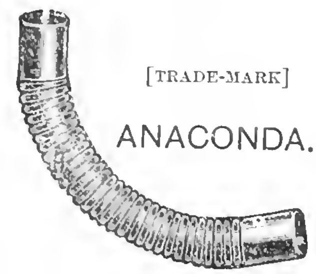

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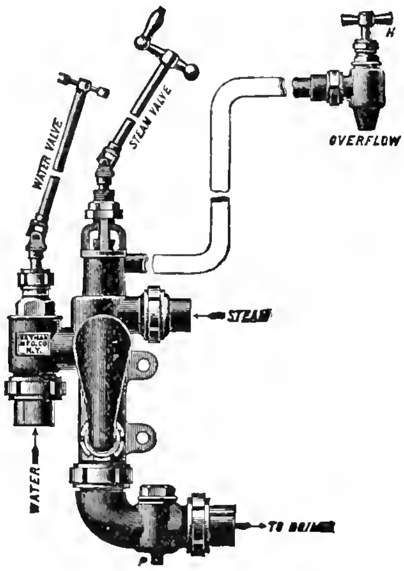

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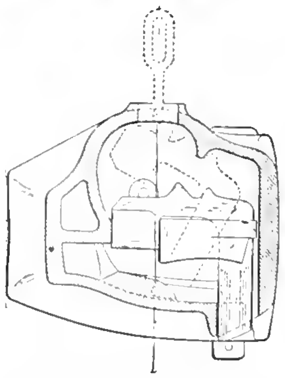

Sectional view back of lock looking forward. Dotted lines show the lock lifted full height for uncoupling and opening knuckle, and ready to couple again.

Any competent mechanical engineer who examines with care the construction of this coupler, finds that all the requirements of service have been met in most ingenious but simple ways. It compares with other automatic couplers, as a high-grade Columbia or Victor bicycle compares with a child's velocipede.

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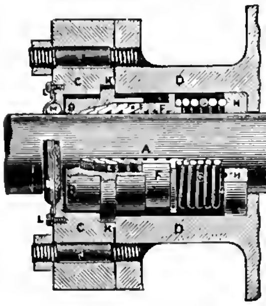

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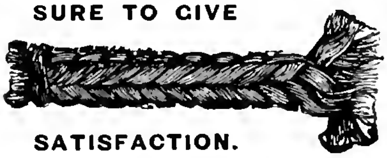

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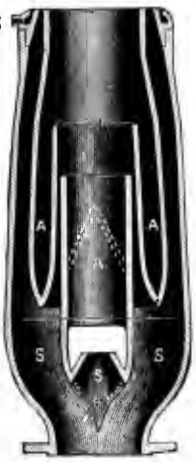
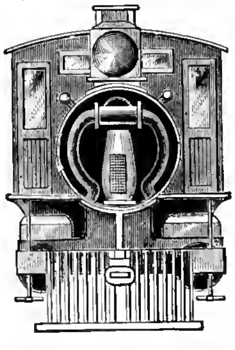


FRONT VIEW.

THIS DEVICE is the invention of JOHN Y. SMITH, the originator of the Smith Vacuum Brake. In the cuts of the Front and Side Views shown herewith, "AA" represent Air Passages; "SS" Exhaust Steam Passages, and "B" an Annular Blower forming part of the Nozzle.



It is an entirely new departure in the construction of Exhaust Pipes for Locomotives. Its distinguishing features are that the exhaust steam is not restricted after it leaves the cylinders, and the gases and heated air in the smoke arch are mingled with the exhaust steam in the exhaust pipe. The exhaust steam is thus superheated and expanded and a powerful, prolonged, pulsating blast is created, which keeps the fuel in a constant state of agitation, and produces more perfect combustion.

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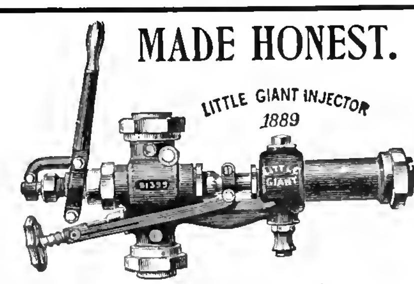

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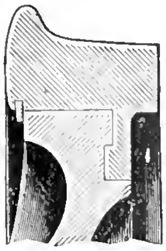

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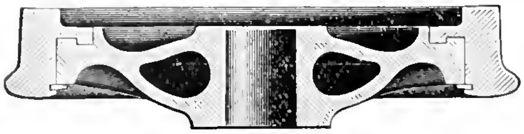

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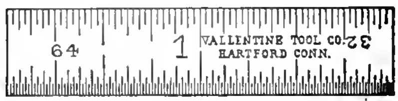

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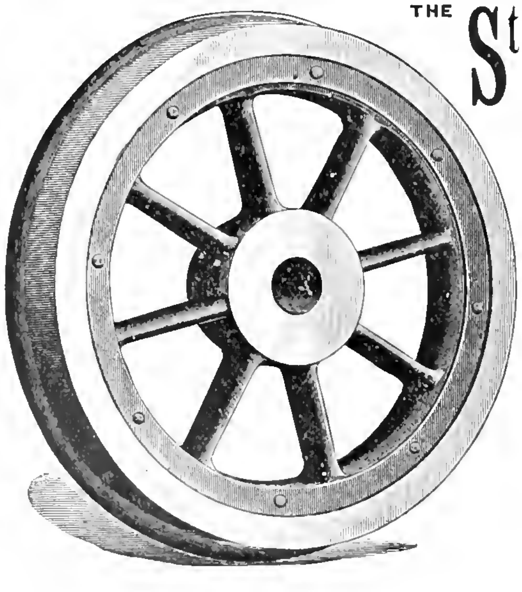

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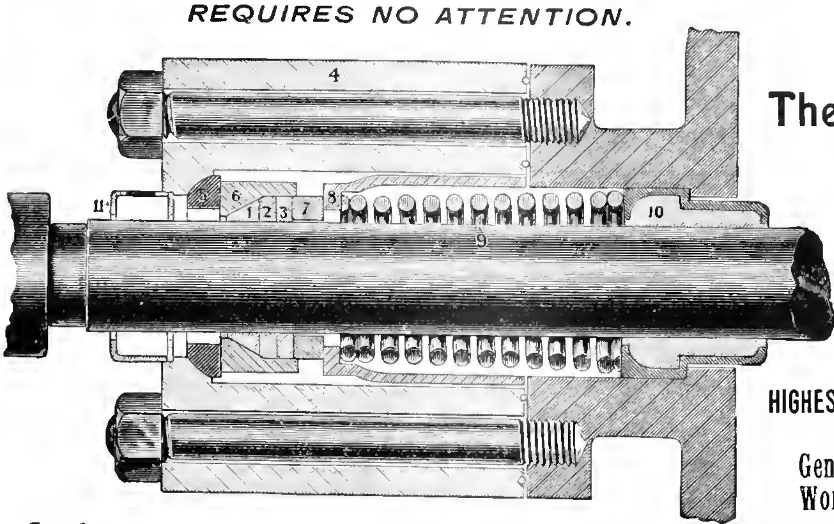

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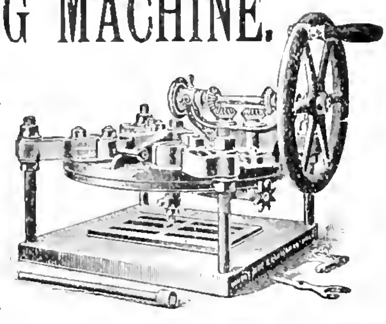

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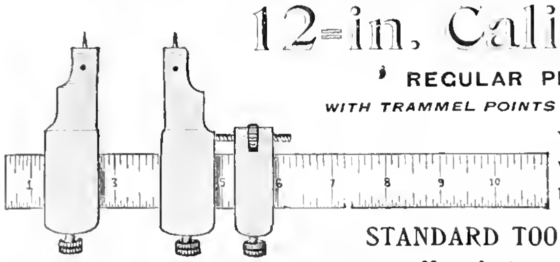

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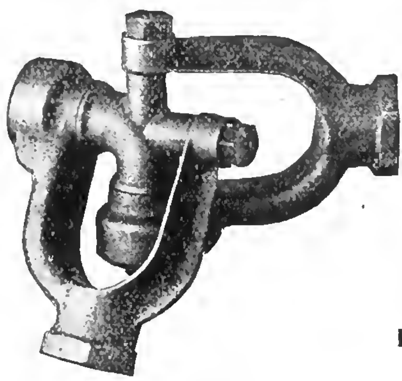

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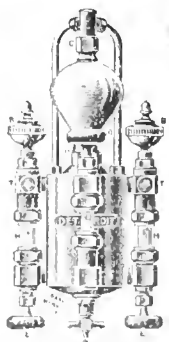

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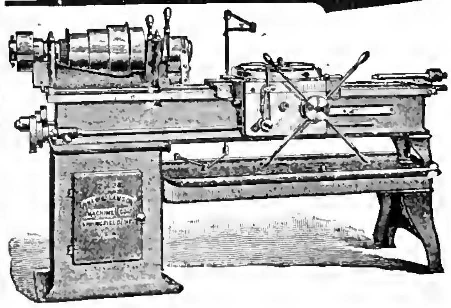

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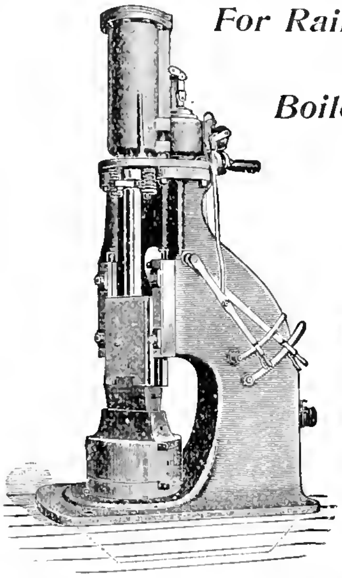

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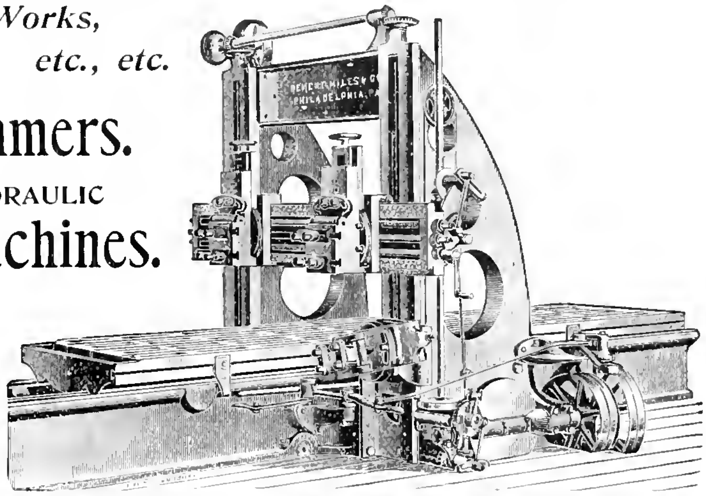

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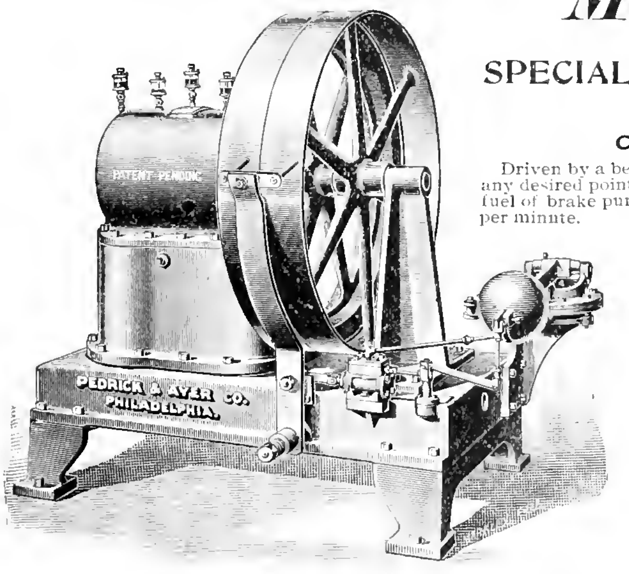

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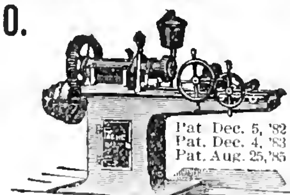

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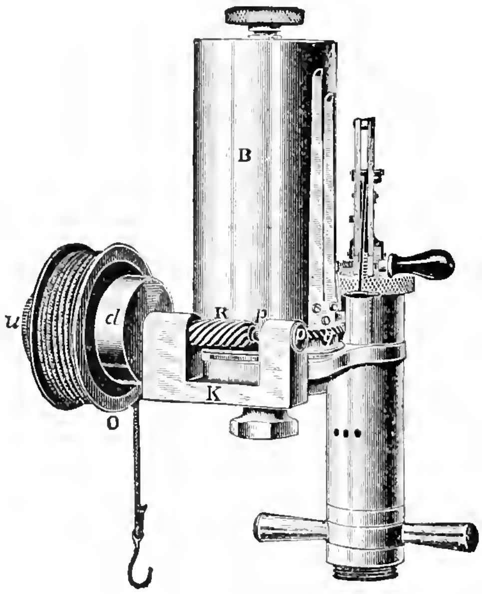

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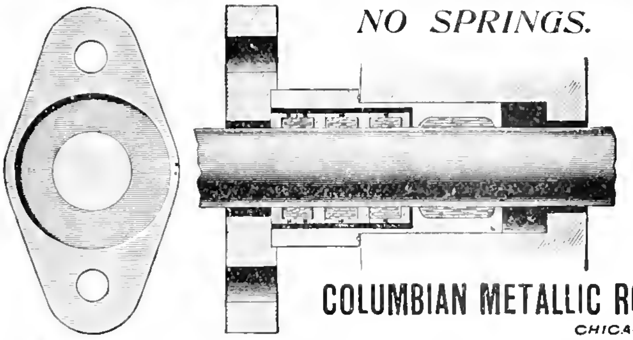

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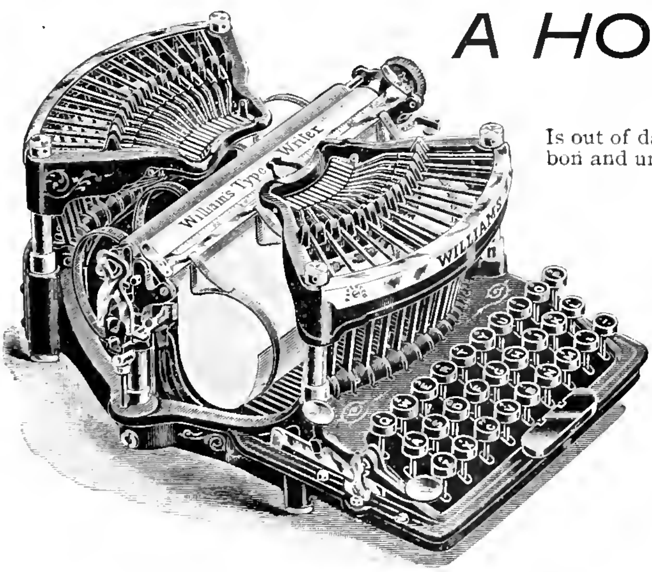

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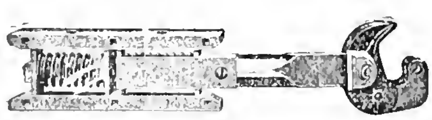

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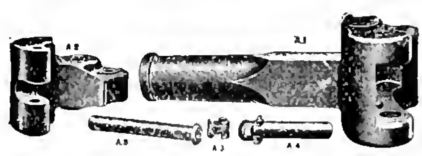

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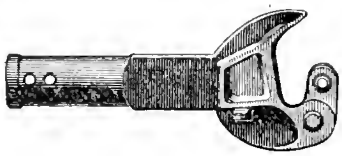

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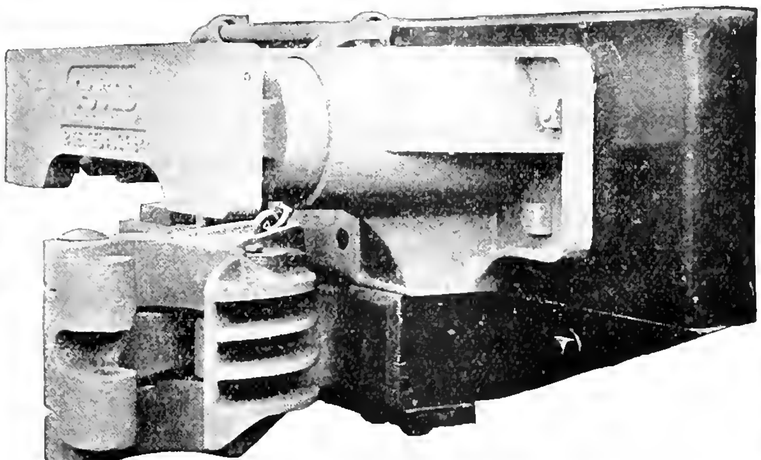

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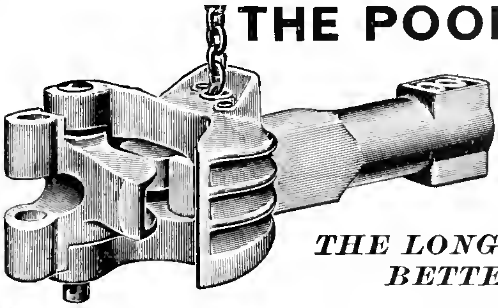

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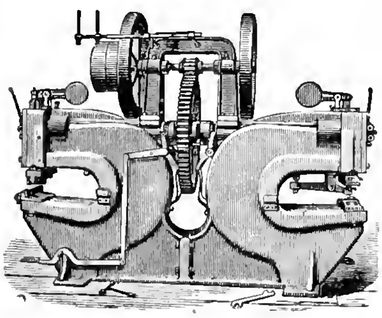

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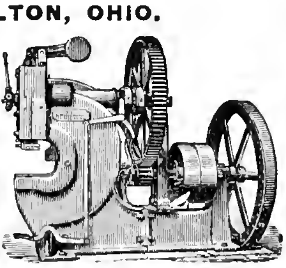

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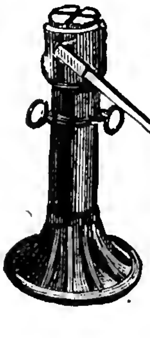

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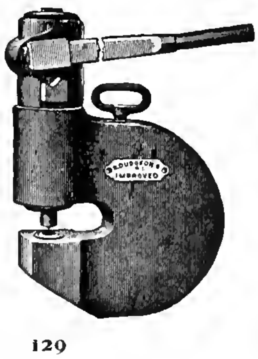

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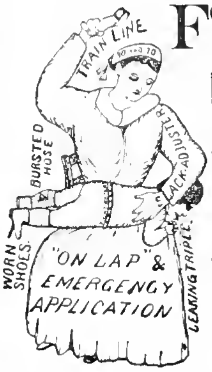

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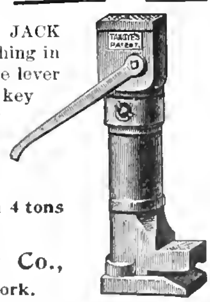

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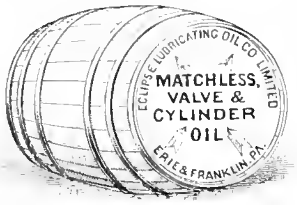

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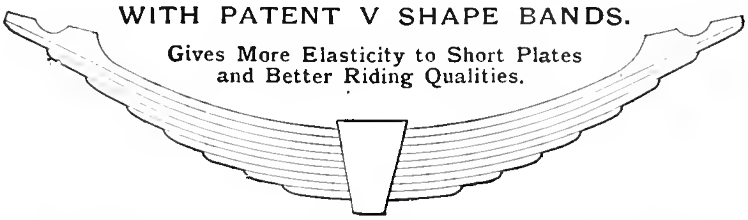

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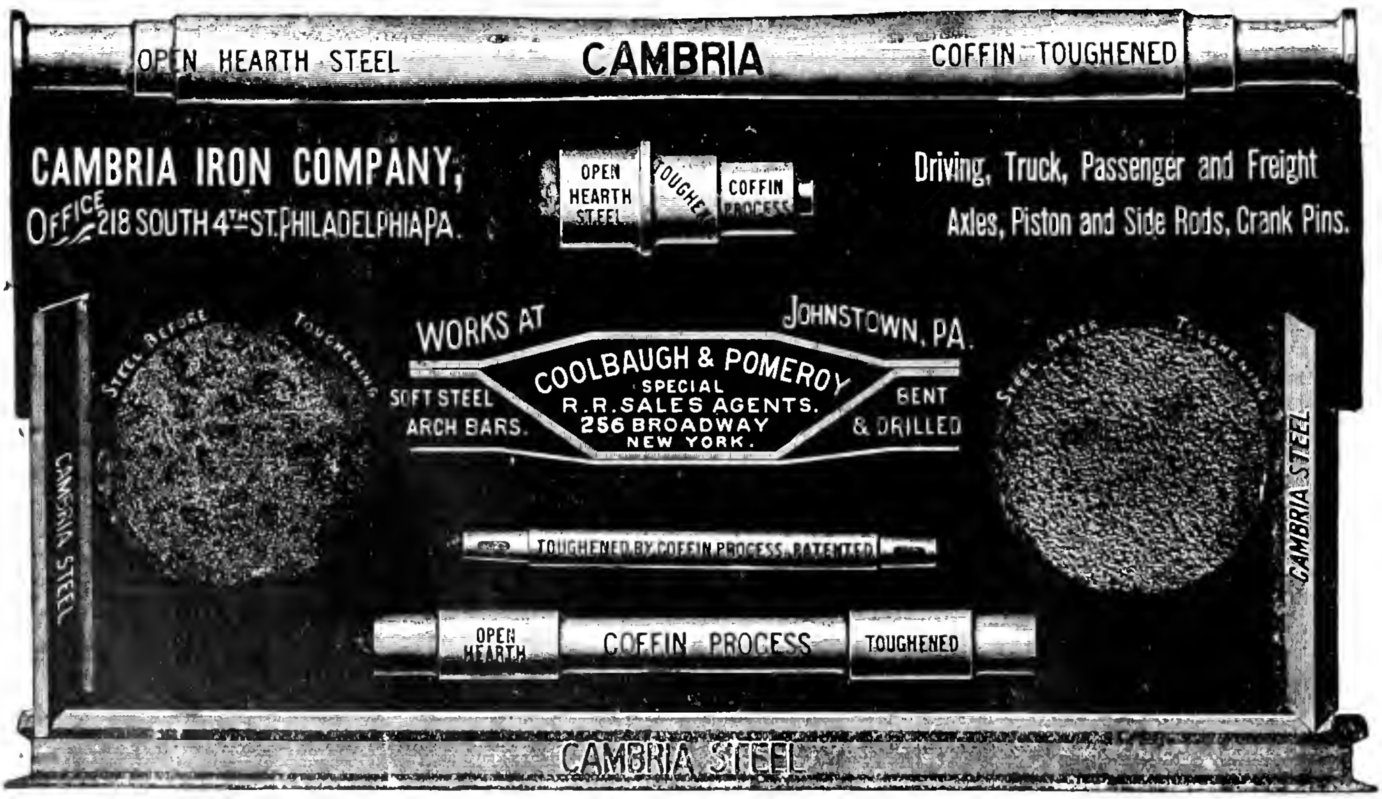

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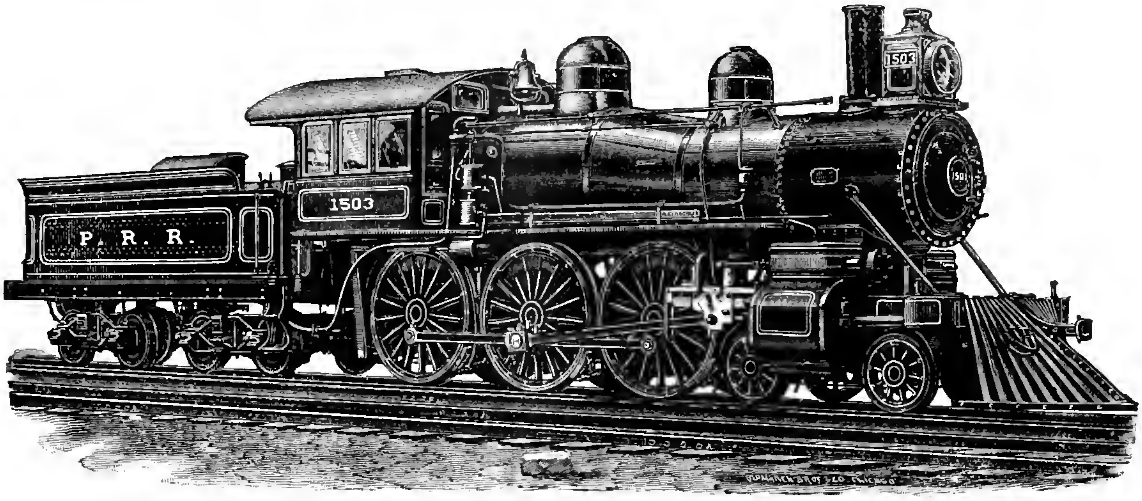

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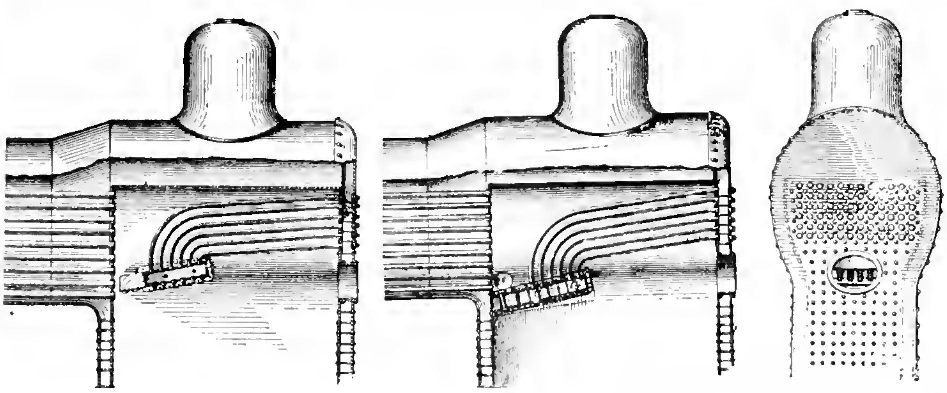

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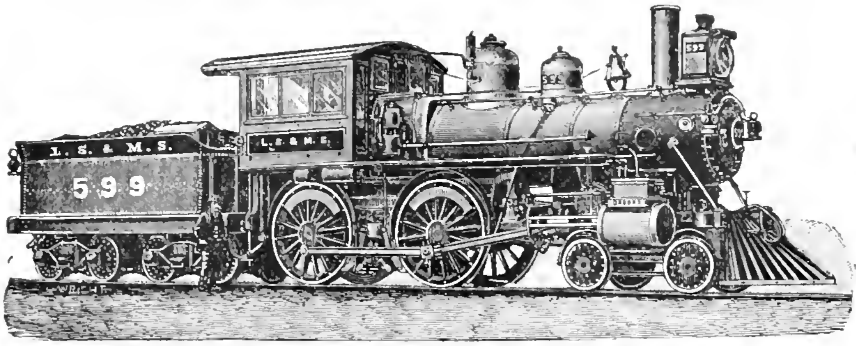

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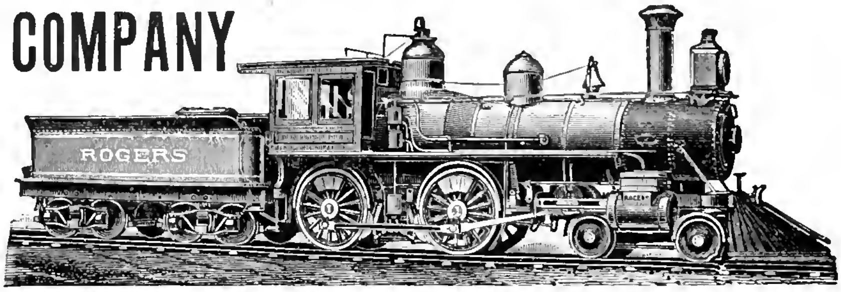

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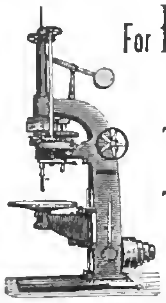

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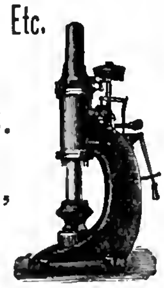

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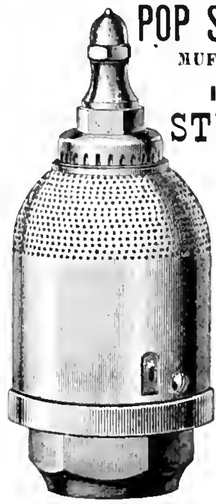

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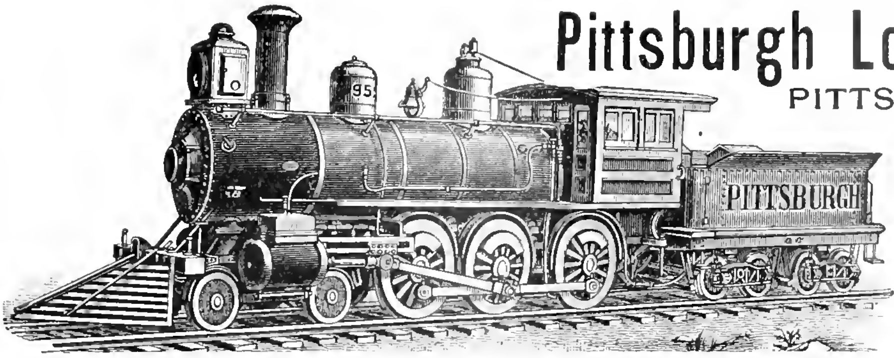

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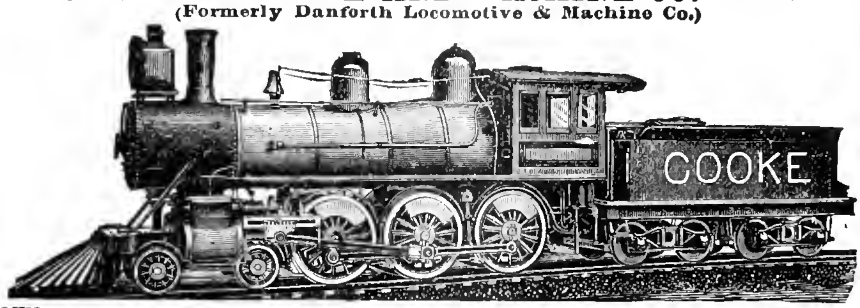

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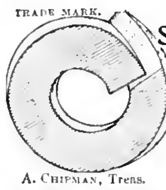

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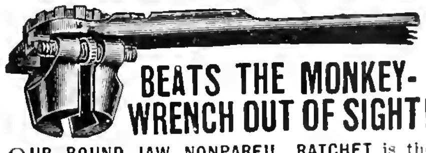

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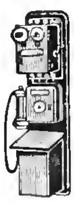

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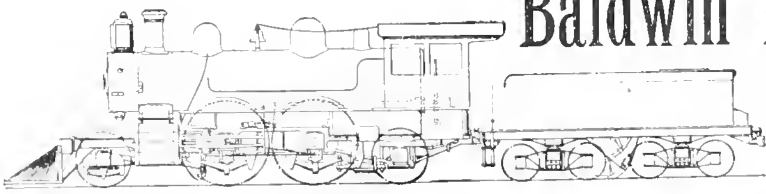

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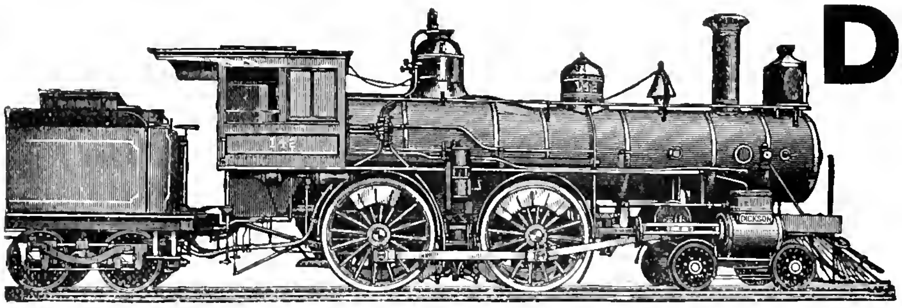

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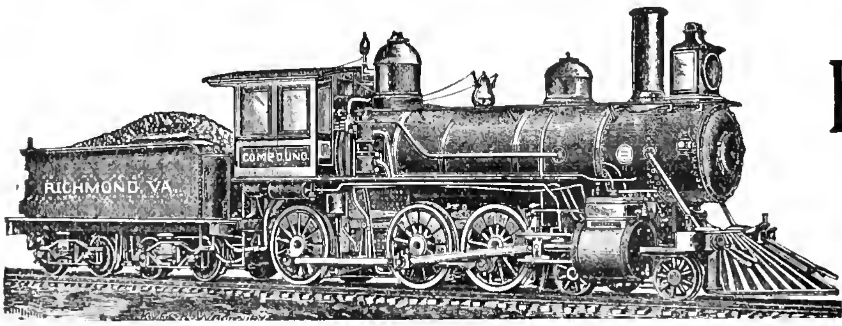

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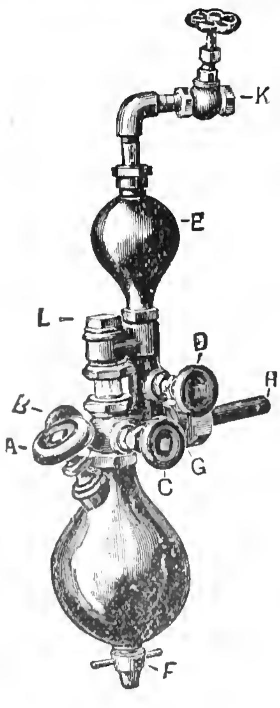

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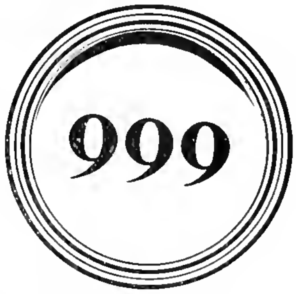

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Steel Tired Wheels.
Krupp (T. Prosser & Son, New York.)
Ramapo Wheel & Foundry Co., Ramapo, N Y
Standard Steel Works, Philadelphia, Pa.

Steel Tires
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son, New York.)
Standard Steel Works, Philadelphia, Pa.

Stone Crushers.
Gates Iron Works, Chicago, Ill.

Switches.
Ramapo Iron Works, Hillburn, N. Y.

Tanks.
Pittsburg Locomotive Works, Pittsburg, Pa.

Tool Steel
B M. Jones & Co., Boston, Mass.

Track Equipment.
Ramapo Iron Works, Hillburn, N. Y.

Tube Expanders.
Henry C. Ayer & Gleason Co., Philadelphia, Pa.
Richard Dudgeon, New York.

Turnbuckles
Cleveland City Forge & Iron Co., Cleveland, O

Turntables.
William Sellers & Co., Philadelphia, Pa

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.

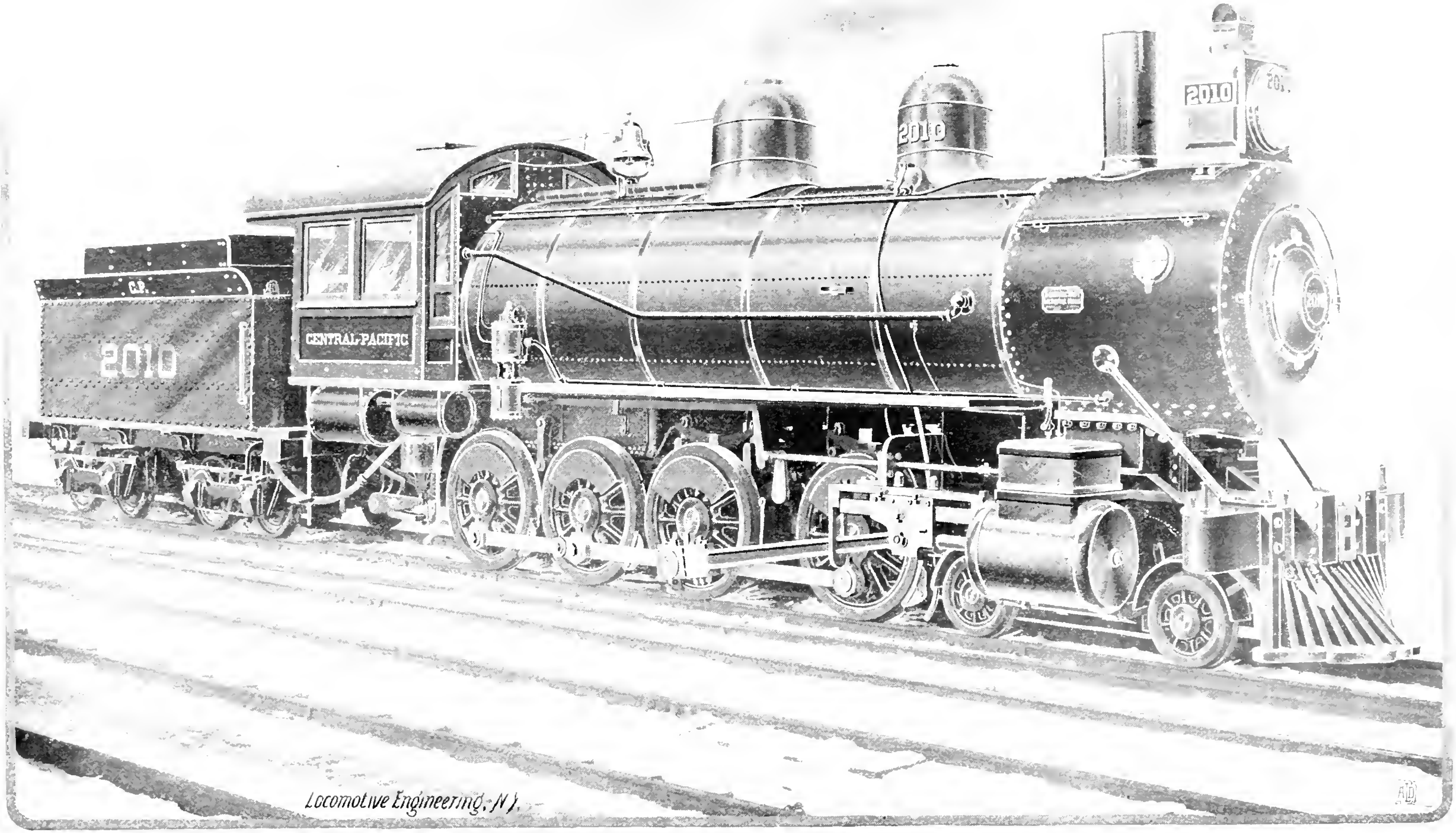
Typewriters.
Williams Typewriter Co., New York.

Valves
Jenkins Bros , New York.
Ross Valve Co., Troy, N. Y.

Vestibules
Gould Coupler Co., Buffalo, N. Y.

Watches
S. N. Clarkson & Co., Chicago, Ill.
John J. McGrane, New York.

Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia, Pa.



Heavy Twelve-Wheeled Freight Locomotive, Central Pacific Railroad.

Designed by H. J. Small, Supt. Motive Power and Machinery. *Built by Schenectady Locomotive Works.*

Volume VIII. New York Number III.

Locomotive Engineering

March 1895.

A Practical Journal of Railway Motive Power and Rolling Stock.

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Heavy Twelve-Wheeled Freight Locomotive for the Central Pacific R.R.

Our frontispiece shows the heaviest locomotive ever built at the Schenectady Works, where 4,233 were turned out before this one was.

This engine may be taken as a good type of the state of the art of heavy locomotive construction for American mountain service, in this year of grace 1895.

This engine is wanting in nothing to make it safe, economical and efficient for heavy hard work.

Fully equipped with the best brake, with pneumatic sander, water brake and Sweeney emergency brake—you may want to know about this.

On the steam chest will be noticed a small valve with a rod running from its handle, back under the running board to the cab. This merely connects the steam chest, by means of a pipe, to the main air drum; in descending a long mountain grade, with twenty to fifty cars of air, it often happens that the air pump gets weary of supplying leaks, and gets hot, then the pressure falls and the brakes let up, and the train runs away. By opening the valves to the Sweeney auxiliary pipe and reversing the engine, both pistons of the engine pump air into the main drum—and pump it amazingly fast. The engineer can keep his full drum pressure up easily by letting the cylinders help him out occasionally. Even when the pump plays out entirely, the train is safe and can be handled, or stopped, by the air brakes.

We must commend the designer for not getting enthusiastic about huge ports and long valve travel on this engine. Coal is worth from $6 to $10 a ton on the Sierra Nevada mountains. The big things are where most wanted here—the boiler and cylinders. The general dimensions of the engine and tender are as follows:

Fuel, bituminous coal.

Gage of road, 4 ft. 8½ in.

Weight of engine, in working order, 173,500 lbs.

Weight on drivers, 146,500 lbs.

Wheel base, driving (rigid), 15 ft. 6 in.

Wheel base, total, 25 ft. 4 in.

Diameter of cylinders, 22 in.

Stroke of piston, 26 in.

Horizontal thickness of piston, 5½ in.

Kind of piston packing, cast iron rings.

Kind of piston rod and valve stem packing, Jerome metallic.

Diameter of piston rod, 4 in.

Size of steam ports, 18 in. long by 1¼ in. wide.

Size of exhaust ports, 18 in. long by 3 in. wide.

Size of bridges, 1¼ in. wide.

Greatest travel of slide valves, 5½ in.

Outside lap of slide valves, ¾ in.

Inside lap of slide valves, 1/32 in.

Lead of slide valves in full stroke, 1/16 in.

Kind of slide valves, American balanced.

Diameter of driving wheels, outside of tire, 51 in.

Diameter and length of driving journals, 8½ in. diam. by 9 in. long.

Diameter of engine truck wheels, 24 in.

Kind of engine truck wheels, steel-tired, cast iron spoke center.

Diameter and length of engine truck journals, 5 in. diam. by 9 in. long.

Diameter and length of main crank-pin journals (main rod), 6 in. diam. by 6 in. long.

Diameter and length of main crank-pin journals (side rod), 6½ in. diam. by 5¼ in. long.

Diameter and length of inter-crank-pin journals, 5½ in. diam. by 4½ in. long.

Diameter and length of F. & B. crank-pin journals, 5 in. diam. by 3¾ in. long.

Boiler, straight.

Outside diameter of first ring, 72 in.

Working pressure, 180 lbs. per sq. in.

Material of barrel and outside of boiler, carbon steel.

Thickness of plates in barrel and outside of boiler, 9/16, 5/8, 11/16 and ¾ in.

Horizontal seam, welt strip inside and outside, butt joint, sextuple riveted.

Circumferential seam, double riveted.

Firebox, length, 120⅛ in. long.

Firebox, width, 41⅜ in. wide.

Firebox, depth, front, 66½ in.; back, 63 in.

Firebox, material, Shoenberger steel.

Firebox, material, thickness, crown, ⅜ in.

Firebox, material, thickness, tube, 9/16 in.

Firebox, material, thickness, sides and back, 5/16 in.

Firebox, water space, front, 4 in.

Firebox, water space, sides and back, 3½ in.

Firebox, crown staying, 7 x ⅞ in. bars welded at ends.

Firebox, staybolts, 1 and ⅞ in. diam.

Tubes, material, charcoal iron.

Tubes, number of, 274.

Tubes, diameter, 2¼ in.

Tubes, length over tube sheets, 13 ft. 6 in.

Heating surface, tubes, 2161.7 sq. ft.

Heating surface, firebox, 184.9 sq. ft.

Heating surface, total, 2346.6 sq. ft.

Grate surface (rocking finger bars), 34.5 sq. ft.

Ash pan, style, sectional.

Exhaust pipe, single, high.

Exhaust nozzles, 5¼, 5½, 5¾ in.

Throttle, balanced valve, double poppet.

Smokestack, inside diameter, 16 in.

Smokestack, top above rail, 14 ft. 8½ in.

Boiler supplied by two No. 10 Monitor injectors.

Tender:

Weight, empty, 35,500 lbs.

Wheels, number of, 8.

Wheels, diameter, 33 in.

Wheels, kind, Canda, chilled, plate.

Journal, diameter and length, 4¼ x 8 in.

Wheel base, 14 ft. 11 in.

Tender frame, Southern Pacific Company's standard; trucks, Southern Pacific Company's standard; center bearing, front and back.

Tank, water capacity, 4,000 gallons.

Tank, coal capacity, 12 tons.

Total wheel base of engine and tender, 52 ft. 9 in.

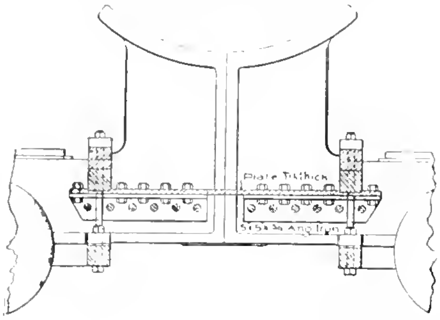
Total length of engine and tender, 59 ft. 6⅛ in.

Engine fitted with — Westinghouse-American combined air brake on all drivers, Westinghouse on tender and for train.

Stiffening Plate for Locomotive Cylinders.

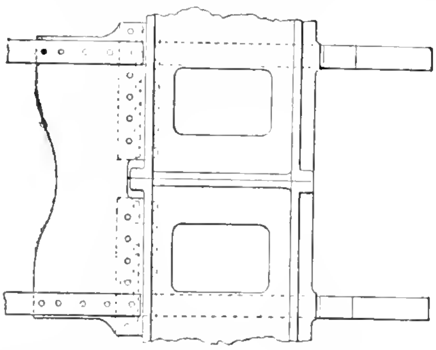
Our illustrations shown herewith will make plain the details of a plan for stiffening the cylinder connections of large locomotives, used by the Rogers Locomotive Company, and designed by Mr. Reuben Wells, the superintendent.

Large locomotives with long fireboxes have a decided tendency to work the



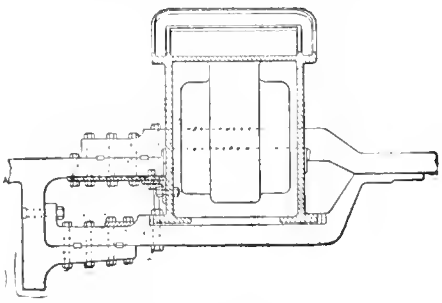
frames loose at the cylinders and the tail bar, as well as to develop cracks and breaks in the cylinder saddles.

This is doubtless caused, in a large measure, by one side of the engine being forced ahead of the other, as in a case



where sand is used on one side or there is grease on one rail.

This tendency, of course, is the same in all engines, but observation has shown that it is less liable to do damage in an engine having a foot plate than in one having only a tail bar. Undoubtedly the heavy



cast-iron foot plate acts as a truss or brace to firmly tie the frames together.

Mr. Wells secures a heavy angle iron, 5 x 5 x ¾ in., to the back of the cylinder saddles, and to this rivets an inch plate extending back on the frames and taking the splice bolts as shown. This, in effect, gives a saddle bearing almost double that usually had, and must have a strong tendency to counteract the bad effects mentioned.

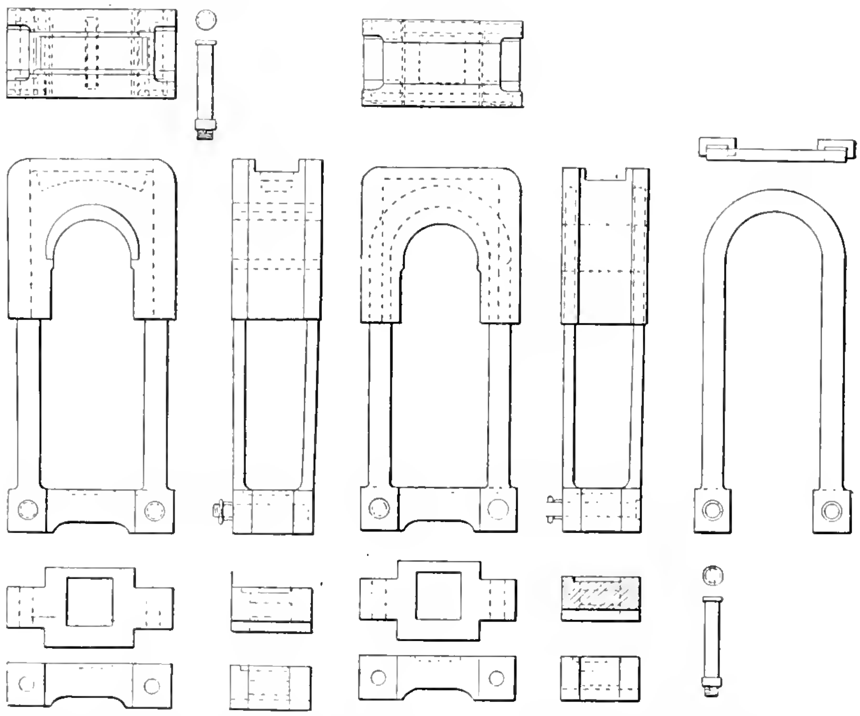
Some New Under-Hung Driver Spring Rigging.

We show herewith, sketches of under-hung driver spring rig used on the Long Island Railroad and designed by Mr. Samuel F. Prince, Jr., superintendent of motive power and equipment.

The form shown at the left is a cast steel box with the hangers cast solid with the box.

The other is a solid brass or bronze box with U-shaped wrought iron hangers cast into the brass. This box is cast in an iron mold, coming out finished—no machine work is done on it, the crown or journal bearing is simply lead lined. The spring seat is of cast iron, just filling the space between the hangers, as shown, and held by two heavy bolts.

This arrangement is cheap, easily han-



dled, and makes an efficient hanger; the spring is where it belongs and is held in place by the hangers themselves.

Brass driving boxes without any machine work on them is a bit of economy worth looking into.

A Question Box.

The D., S. S. & A. enginemen have a nice room fitted up over the storehouse at Marquette, Mich. There is a long table filled with current periodicals, models, etc. On one side of the room is an immense profile of the road, and drawings and standards are shown. The men have an educational club, of which the traveling engineer is president, and have discussions on technical subjects and matters that come up on the road.

One of the best things they have is a question box. Into this any engineer or fireman can drop a paper containing his question; no one has a key except the president, and he opens the box and writes the question out on a blackboard. It remains up until thoroughly discussed and thought over, not only at meetings but any time, as the men stay in the room considerable, being convenient to the roundhouse and well heated. By the use of such a blackboard, every accident and incident on the road may be made an object lesson to every man attending the club.

Some Official Abbreviations.

"There's a good deal of fun in the old man," said the operator, as General Superintendent Bradley of the West Shore put his specs in his pocket and got on the train. "One of his clerks was telling me a pretty good story on him just the other day.

"It seems a section gang got hilariously full one pay-day night, got on a train, created a disturbance, resisted ejectment, and got reported to the superintendent. The superintendent, after the manner of his kind, wrote a note, pinned it to the report, and sent it to the roadmaster; he added to it and sent it to the general roadmaster; and the general r. m., who was new, sent it to the general superintendent, asking for instructions. Mr. Bradley read it over and indorsed with blue pencil, "G. H.", and thumped his official stamp on it.

"Several days afterward, the general roadmaster dropped in on the general superintendent, and after a brief visit, pulled out the instructions.

"'Mr. Bradley,' said he, 'I got your instructions about Sullivan's gang, but dog-goned if I know what "G. H." means. What is it?'

"'G. H? Why,' said Bradley in a surprised tone, 'that means Give 'em h—l!'"

Construction—The Telegraphic Systems.

[THIRD PAPER.]

By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

The telegraphic systems derive the name from the method used in conveying information from one station to the next regarding the position of trains and the state of the block.

The equipment of a station consists of:

First—A wire and the necessary telegraph instruments, or if so desired, bells may be provided, if a suitable code is arranged that will cover all the conditions likely to present themselves in the blocking of trains.

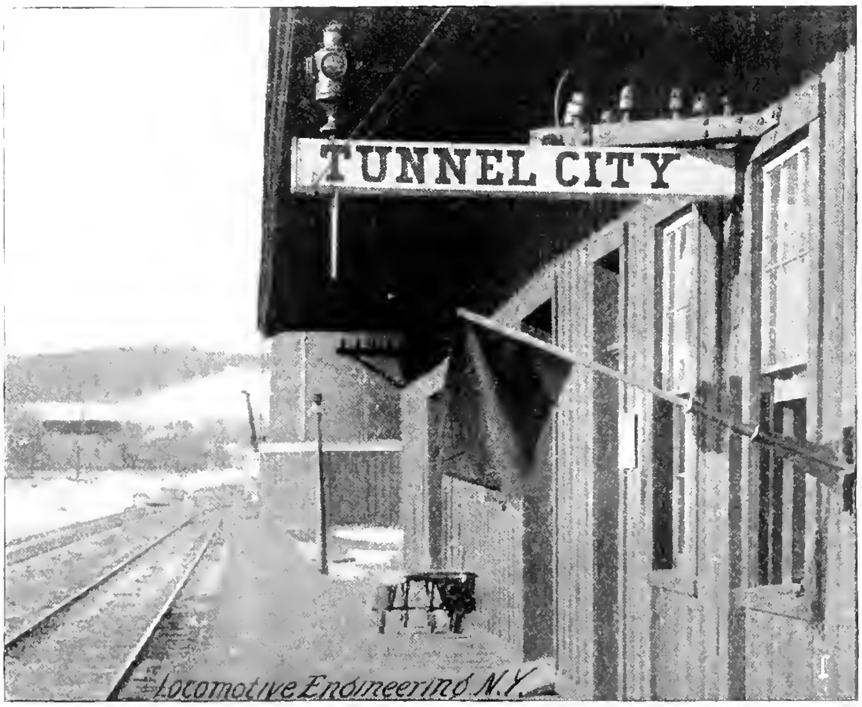
Second—Of a signal by which information can be conveyed to engineers and trainmen of the condition of the block, and whether or not they have the right to proceed.

Third—Of a lever, if such is used, and the necessary connections for the proper working of the signal.

The construction of a semaphore signal has already been explained, but as a road may block trains by using any one of several different designs, it is necessary that a description be given of the ones most generally used. While most of the fixed signals are used for the blocking of trains, they are often used solely as a train order signal (commonly called by trainmen "order boards"), so that while there may be a difference in the information conveyed, there is no difference in the construction of the signals used for the two purposes.

The simplest form of signal is a flag stuck in the edge of the platform, or placed in some more conspicuous position, where trainmen will be most likely to see it.

A very good arrangement, as shown in Fig. 1, is to bolt a simple bracket, in which the flag staff may be placed, to the outside of the station building. Trainmen will soon learn its location and will then know just where to look for a signal in case one should be put out for them. A little hook on top of the casting near the end serves as a catch to hold the lantern, when, at night, one is used.



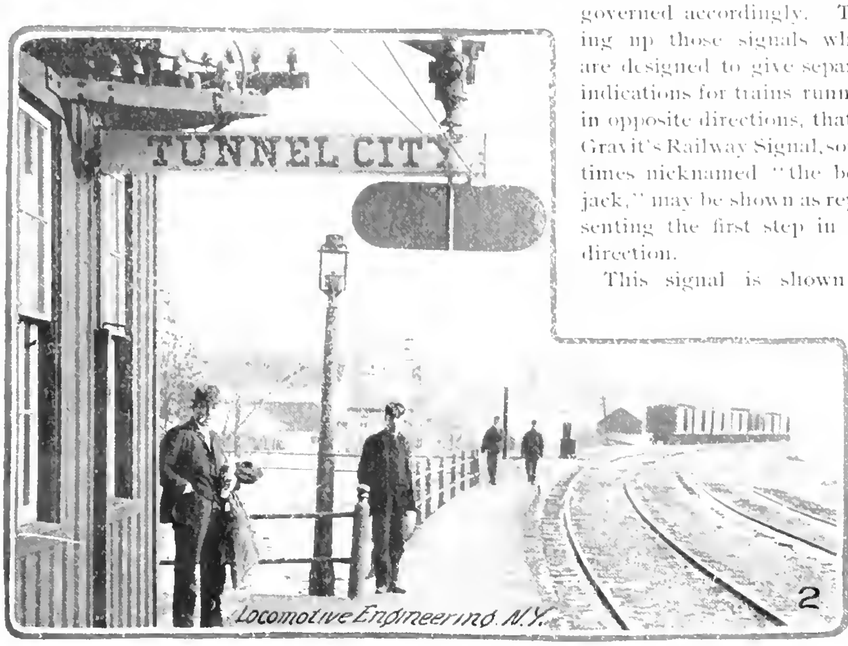
The "Swift Train Order Signal," as shown in Fig. 2, is something of an advance from a simple flag, and is really a much better arrangement, as it is placed in a more conspicuous position, and, from its being made of sheet iron, cannot be blown about by every wind, but is always seen to the best advantage. Its construction is very simple, consisting of an oval-shaped piece of sheet iron, riveted at its center to a shaft. The turning of this shaft, and with it the sheet, through a quarter of a circle, by means of a bell crank and a lever placed in the operator's office, is the method used in giving the different indications. The night indications are made by a lamp placed on the top of the shaft, which is made to extend up through the framework supporting the signal. The lamp is the same as an ordinary switch lamp, having two of the lenses red and the other two white. These are arranged so that the light, as seen from an approaching train, from either direction, will show red or white, and give the same indication as is given by the board.

If the board is set parallel with the track, it will not be visible to an approaching train, and is, therefore, understood to mean that there are "no orders," or that the line is "clear." If the board is set at right angles with the track, it will be plainly visible, and the indication is made to "call for orders," or "danger, track blocked." Hooks are provided in the operator's office to hold the lever in the position in which it is placed. These hooks are painted red and white, corresponding with the indications made by the signal, to always remind the operator of the position in which the signal has been placed.

The signal shown in Fig. 3 is one used extensively on the E. T., V. & Ga., and other roads, and although of a semaphore type, the indications being made by the position of the blade, it is of a radically different construction. A cast-iron frame work or bracket bolted to the outside of the station building, carries at its outer end two shafts, which are set at right angles with each other, and are provided with the necessary levers and cranks to turn them through a quarter of a circle. A blade bolted to the horizontal shaft and painted red, serves, when in a horizontal position, to give the danger indication; a counterbalance weight is provided on the opposite side of this shaft to make the blade assume the danger position, should any of the parts become disconnected.

The lower end of the vertical shaft is provided with a casting, to which are bolted two blades, in the manner shown in the cut. These blades are painted white and are spaced a sufficient distance apart to allow the red blade to pass between them, when it is lowered from the hori-

zontal position. This blade, if at right angles with the track, will, of course, be seen by an approaching train, and being in the vertical position would indicate "all



SWIFT'S TRAIN ORDER SIGNAL.

clear." If parallel with the track, only the narrow edge of each would be presented, and no indication would be given, as they could not be seen.

To indicate "danger," the arrangement of the cranks attached to the two shafts is such, that if the red blade is in the horizontal position, the white blades are parallel with the track, and the red blade only will be seen. The "all clear" signal is given by pulling the lever and turning the white blades through a quarter of a circle, bringing them at right angles to the track, and on both sides of the red blade, which is lowered from the horizontal position, thus leaving only the white blades visible, and consequently giving the "all clear" signal or "safety" indication. The lamp, supported by the vertical shaft, is the same as that used for the Swift signal, and gives the indications by color that correspond with the indications made by the blades.

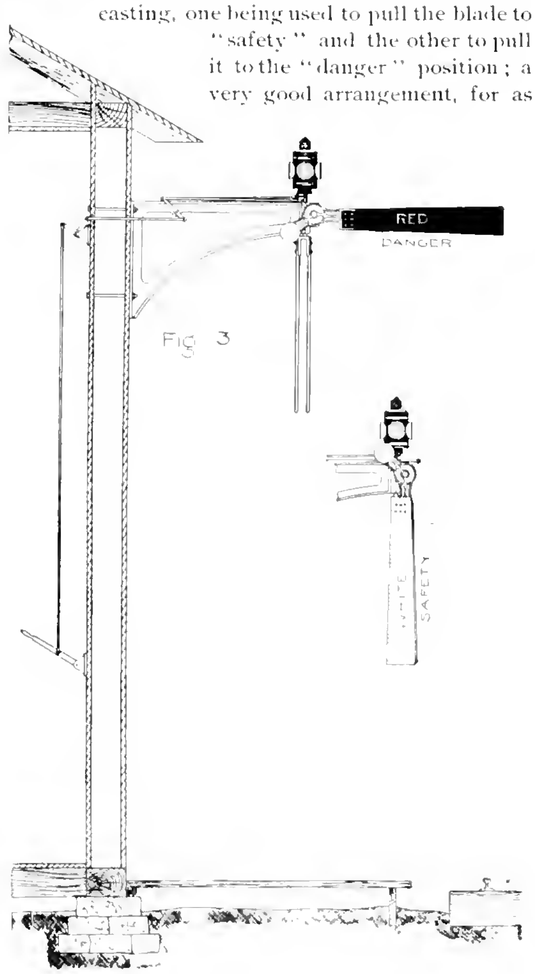
This signal, it will be seen, is one in which the indications are given by color, as well as position, and beyond the fact that it is impossible to designate with the arrangement, as shown, the particular direction in which it is desired to hold trains, the indications as made are clear and unmistakable. The great objection, however, to a construction of this kind—one that is of great force in a northern climate—is that in bad weather the blades are very apt to become clogged with snow, or else frozen together, in which case there is a possibility of a wrong indication being given, and a certainty that the signal could not be worked.

With all the signals that have so far been described, it is impossible to designate by the signal the direction in which it is desired to block trains, so that to prevent mistakes, every train which is at a station where the danger signal is displayed must assume that it is intended for it and be governed accordingly. Taking up those signals which are designed to give separate indications for trains running in opposite directions, that of Gravit's Railway Signal, sometimes nicknamed "the bootjack," may be shown as representing the first step in this direction.

This signal is shown in Fig. 4, and is of very peculiar construction. It is in general use on the Lake Shore & Michigan Southern road. The two blades, which are fixed at an angle of 90 deg. with each other, are so mounted on a shaft that they can be turned through a complete circle. A lever placed in the operator's office serves, by means of a chain, an up and down rod which also acts as a weight, and a rack and pinion, to turn the shaft and with it the blades to any of the four positions it is necessary for them to take. On the lever stand there are four notches or positions for the lever, with lettered plates at each, indicating to the operator the position of the signal blades, as "All blocked," "Clear for west-bound trains." The lamp case seen in the cut below the signal blades, is fitted with the necessary colored lenses, a lamp being raised or lowered behind them, so that the light will show through the lenses, giving a color indication in each direction that will correspond with the indications made by the blades. Openings in the case on the station side are also provided with colored glasses, so that the operator can at all times see that the correct indication is given by the lamp. With this signal it is impossible to indicate either "danger" or "safety" in both directions and have the blades occupy the usual positions. This is certainly a great objection, as it becomes necessary to have the blades at different times occupy different positions when indicating the same thing; danger being indicated by a horizontal position of the blade in one case and an inclined position above the center in another; safety, likewise, being indicated by a vertical position and also an inclined position below the center.

The Mozier three-position semaphore signal, shown in Fig. 5, is a signal that is somewhat of a departure from the ordinary semaphore signal, not only in its construction, but in the manner in which the several indications are given. It is in general use on the Erie road, and is reported as giving very great satisfaction. It is designed to give the three indications—danger, caution and safety—with a single blade, but instead of making the cautionary indication by the usual position *below* the center, it is made by raising the blade to an inclined position *above* the center. This position, as well as the general arrangement of levers, etc., is clearly shown in the cut.

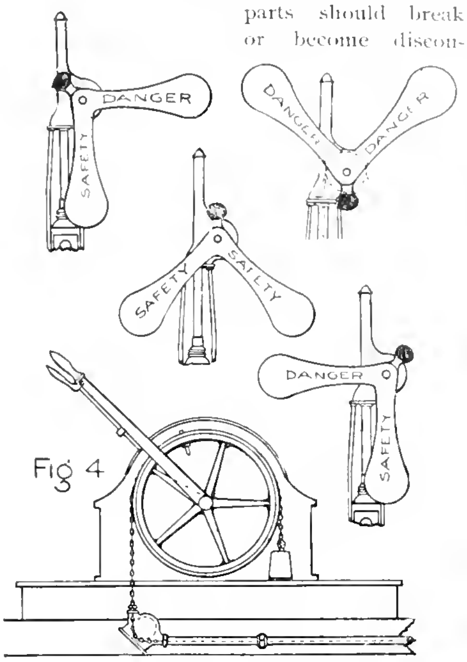
In the construction of the signal, two chains or wires are run from a lever placed in the operator's office to a pulley fastened on the pole, and from there to the signal casting, one being used to pull the blade to "safety" and the other to pull it to the "danger" position; a very good arrangement, for as



SIGNAL USED ON E. T., VA. & GA. R.R.

both motions are positive, it can be depended upon that the signals will occupy positions corresponding with the positions of the levers. A weight sliding in a vertical plane on two roller bearings is suspended by means of a chain from two pins on op-

posite sides of the center of the arm-plate casting, for the purpose of making the signal assume the danger position if any of the parts should break or become discon-



Gravit's Railway Signal.

nected—a very necessary thing, as has already been pointed out.

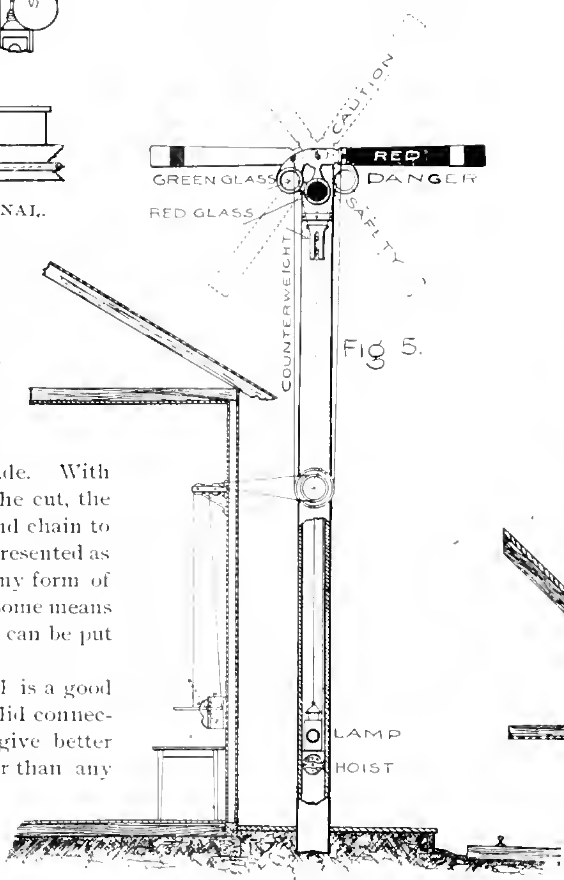
The arm-plate casting is made to hold two glasses, one red and the other green, that one being brought in front of the lamp which, by its color, will give an indication corresponding with the indication made by the blade. With the arrangement as shown in the cut, the lamp is raised by a windlass and chain to the top of the mast, which is represented as being made of iron pipe, but any form of pole will answer just as well, if some means be provided by which the lamp can be put in place.

The construction of the signal is a good one, although I believe that solid connections to the arm-plate casting give better results, and are certainly safer than any chain or wire as is used in the present case. The objections to giving a cautionary indication by any signal have already been noted, but as the operation of each road is a problem in itself, to be dealt with by men holding very different opinions on such matters, it is not to be wondered at that the practice should be very different on the different roads in such an important branch of railroad operation as signaling.

A semaphore signal that is very extensively used in the South is shown in Fig. 6. It is of a somewhat cheaper form than the ordinary semaphore, and is operated by means of a cable passed around a circular rim cast on the arm plate. The arm-plate casting is made heavier than the blade, so as to carry the signal back to the danger position when the lever is released. It will be noticed that the red lens is carried in an arm projecting above the center and not in the counterbalance part of the arm-plate casting; a lens being used instead of an ordinary red glass so as to concentrate the rays of light, as the lamp used is an ordinary hand lantern. The construction of this signal is very light, and for severe climates is not a good one, as snow or ice is very apt to make it stick in the "all clear" position.

The signal shown in Fig. 7 is that of the three-position signal used on the Pennsylvania road. A very noticeable feature in the design of this signal is that the blade, when in a truly vertical position, projects from the side of the pole so as to be plainly visible and give a positive indication that a clear signal is intended.

The arm-plate casting is made to hold two glasses, a red and a green, as the usual



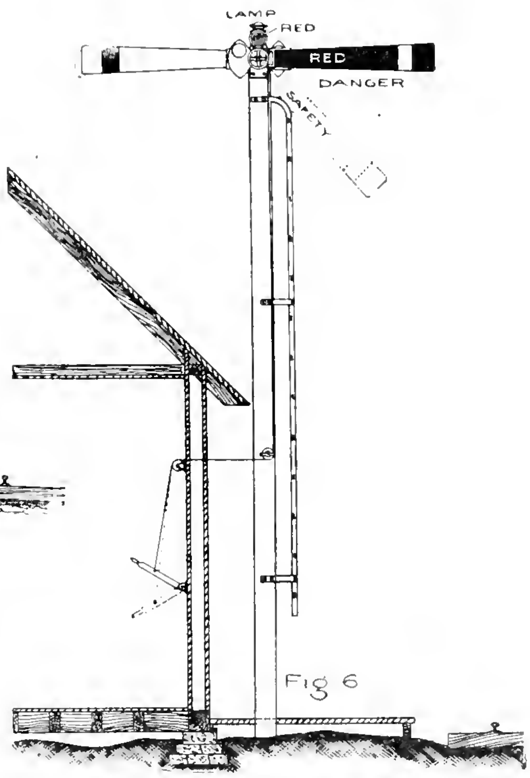
Mozier Three-Position Semaphore Signal, as Used on N. Y., L. E. & W. R.R.

practice on this road is to allow the operator to give a cautionary signal (the inclined position of the blade) whenever it is desired to block trains permissively.

The arrangement as used on the St. Paul road is shown in Fig. 8, and is one, I believe, that fulfills all the requirements of a good signal, and at the same time is simple in construction and of low cost.

It will be noticed that the ends of the blades are pointed, a practice that the St. Paul road has been the first to adopt; the reason for doing this being the desirability of making some distinction between a block signal and a signal used at an interlocking plant. Undoubtedly some such distinction must be considered advisable, when it is remembered that with a signal used at an interlocked crossing the engineer must stop his train at the signal if at danger, the derail not allowing him to run by it. When, with a block signal, he is allowed to pass it, if it is necessary to do so, and have the train stop in front of the station. Certainly it is not consistent practice to allow him to run by a signal in one instance and require him to stop at the signal in another, if there is no way in which he can distinguish one from the other. What objection can there be to pointing a block signal blade, if in any way such pointing helps to denote the character of the indication given?

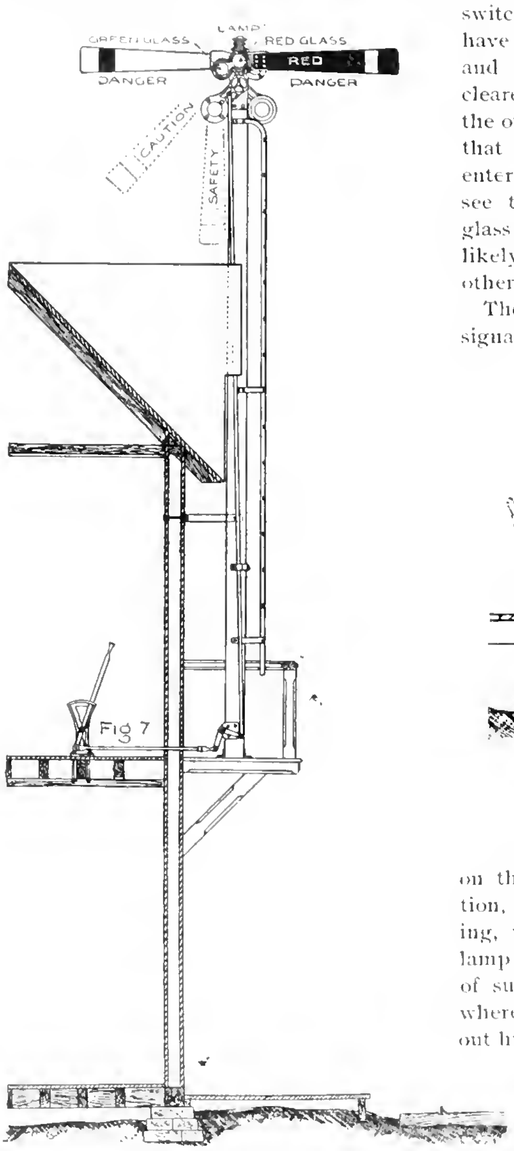
In the equipment of a station, only those parts have been shown in the drawings which are necessary to work a signal placed in front of or near the station. When a distant signal is used in connection with the home block signal, it is necessary to use a lever stand of much heavier construction than any that have been shown, as it requires about all the strength the average man possesses to clear a signal placed a distance of over 1,500 feet. The levers must be so interlocked that the distant signal cannot be cleared until after the home signal, and in returning the signals to the



Signal Used on Cent. R.R. of Ga.

danger position, that of the distant signal must be moved first. A lever stand provided with the necessary locking and which is of simple construction, is shown in Fig. 9, the parts by which the locking is accomplished being shown in plain view in Figs. 10 and 11. The long bars, having a

notch in one side, are called "locking bars," one being provided for each lever. The cross piece having its end tapered to fit in the notches cut in the bar, is called a "locking dog," and is made of such a length as will allow it to fit in between the two locking bars, provided one end be placed in one of the notches, as shown in Fig. 10. It will be seen in this figure, where both levers are supposed to be in the normal position—that is, with both signals at danger—that from the position of the locking dog, the home signal lever is the only one

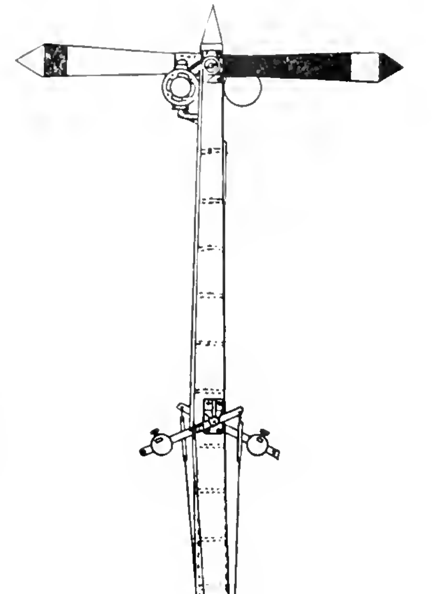


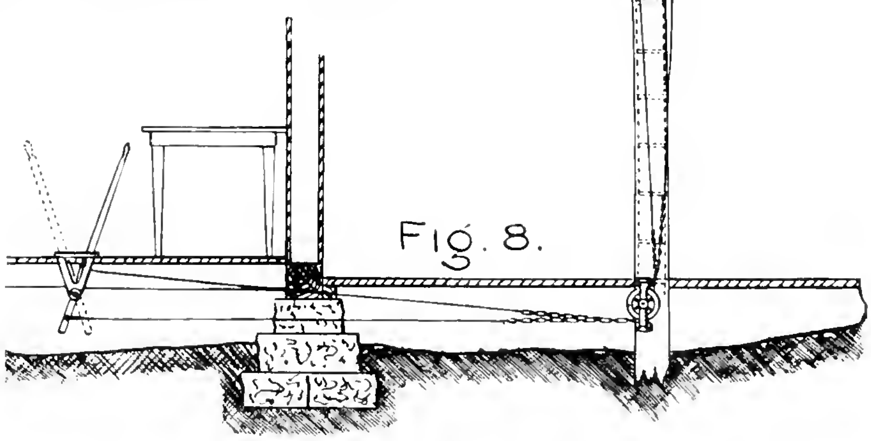
Block Signal Used on Penn. R.R.

that can be moved. If this lever be pulled over and the signal cleared, the bar will be drawn back, bringing the notch in that bar opposite the one in the other bar. This now makes it possible to pull over the distant signal lever, as the locking dog is forced over into the notch in the other bar, as shown in Fig. 11, locking the home signal lever in the reversed position, until the distant signal lever is once more returned to the normal position.

In locating the signals at any station, several things have to be taken into consideration, which are regulated to a great extent by the system and the number of signals used. Where the two signals are placed on one pole, the location of the pole does not fix the exact spot at which trains must stop, as it frequently happens that trains have to pass the signal when at danger, in making a stop in front of the station. An arrangement of this kind has but one thing to recommend it, and that is its cheapness, while there are several grave objections. As has already been stated, a train must often run by the signal when at danger, to make a stop or to do any switching at the station. At night, if they have so run by the signal, the engineer and trainmen cannot see if it has been cleared, and the conductor has to walk to the other side of the signal to make sure that it has been cleared for his train to enter the block. That the operator can see the light showing through the red glass of but one signal, and would not be likely to detect it should the glass of the other signal get broken.

The best practice in locating such a signal at any station, is to put the signal

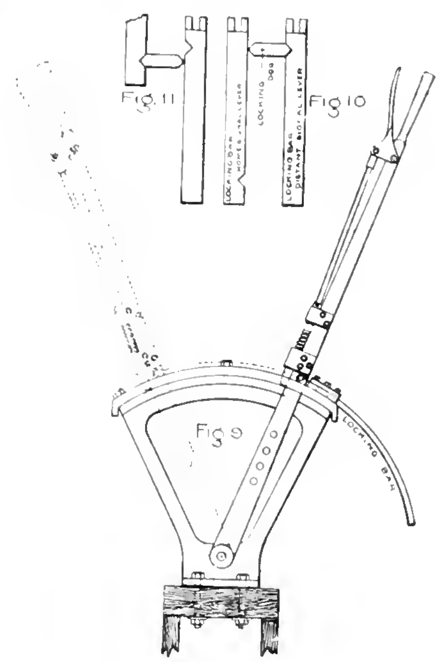




Block Signal Used on C., M. & St. P.

on the same side of the track as the station, and at either end of the station building, where the operator can see the signal lamp from his office window. The object of such a location is to have the signal where it can be seen by a conductor without his having to look through or over a train to see it, and also where the operator can seen that the light is burning properly, and that at least one glass is in its place. Of course, if the view is such that on account of a curve, buildings, or what is more likely, a water-tank, the signal—so located—would not be seen, it would have to be placed on the opposite side of the track. Where this will not overcome the difficulty, the best plan is to put the signal on a bracket pole, as is shown in Fig. 12, bringing the blade very nearly over the center of the track.

A better arrangement, if a road can go to the necessary expense, is to have each of the two signals on a separate pole, placed on the right-hand side of the track as viewed from an approaching train, and at a sufficient distance past the station to allow the train to make the stop in front of the station without having to pass the signal. The operator would then be able

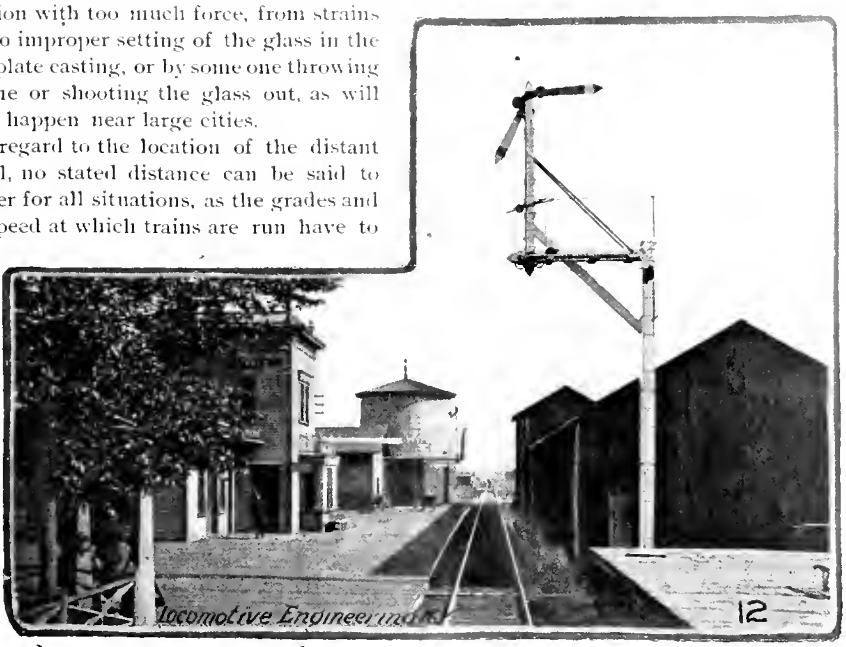


to see each signal light, and would be likely to notice it were either glass

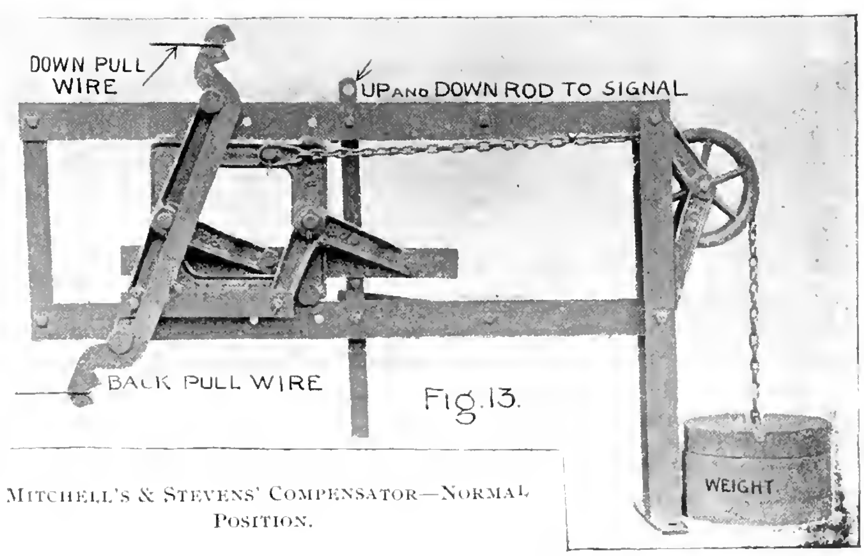
broken. This is a very important point, when it is borne in mind that a signal is changed from "danger" to one indicating "safety," whenever this happens; and that it happens very often is not to be wondered at when it is seen that a glass may be broken by the jarring occasioned by letting the blade return to a horizontal position with too much force, from strains due to improper setting of the glass in the arm-plate casting, or by some one throwing a stone or shooting the glass out, as will often happen near large cities.

In regard to the location of the distant signal, no stated distance can be said to answer for all situations, as the grades and the speed at which trains are run have to be considered before deciding at what distance from the home signal such a signal should be placed. Ordinarily the distance is 1,200 feet, but as the distant signal is the governing one, as regards the speed of the train, it would seem that a greater distance than this is to be preferred, as in so short a distance a heavy freight or fast passenger train cannot be brought to a stop, should they pass the distant signal at schedule speed. While it is possible to work a signal a distance of 3,000 feet from the home signal, it is not advisable to go beyond 2,500 feet, owing to the difficulty of keeping the wires properly adjusted and the labor required to clear the signal. The change in the length of such a wire, due to expansion and contraction, is considerable; so that unless very carefully looked after and adjusted, the blade will not be brought to the proper position, and the engineer will be in doubt as to what the signal indicates.

Of course, the objection to such long wires would, to a great extent, be done away with if a good compensator might be had to automatically take up the changes in the length of the wire, so that the proper working of the signal would not be affected. At the present time, only one wire compensator, that invented by Mitchell & Stevens, can be said to be a practical success, and were it not for its cost, it would certainly come into more general use. Its construction is very plainly shown in Fig. 13. The expansion and contraction of the wires are taken up by a sliding frame, the wires being kept taut under constant tension, by means of a weight. The objection to the use of a weight is that if the wire that pulls the signal back to the danger position were to break, the weight would pull the signal to the "clear" position, and thus give a wrong indication. To overcome this objection, the two wires are attached to a loose lever, as shown in the cut, which would be pulled away from the cranks if either wire were to break, thus leaving the signal free to return to the danger position by the force of gravity.



A Bracket Pole.



Mitchell's & Stevens' Compensator—Normal Position.

There is one question in connection with a telegraphic system of signals, regarding which very different views are held by different superintendents, but about which I think there should be no doubt as to which is the best practice. It is this: Shall the block signal be also used as an order signal, or shall there be two signals at a station for trainmen to observe—one the block signal and the other the train order signal? The argument in favor of using the two signals is that an operator, on receiving a train order, has to put the train order signal at danger before the "O. K." is given by the train dispatcher, and is therefore certain to stop a train for which he has an order; that with only the block signal, which is kept at danger unless cleared for a train, there is nothing to depend upon for the delivery of the order, except the operator's memory, and that on hearing the whistle for the signal, he may forget that he has an order to deliver and give the train a clear signal, particularly if he had fallen asleep and had just waked up.

The argument in favor of making the block signal answer for both purposes, and which I believe to be the stronger of the two, is that the engineer is more likely to take the indication of the more conspicuous signal and forget to look at the other one, than is the operator to forget that he has an order for a train. That this is true, and that an engineer will sometimes fail to look at the order signal while taking the indication of the block signal, the writer is convinced of, from the fact that two such instances have come within his knowledge.

A Curious Accident.

At the Ionia, Mich., shops of the D., L. & N. the writer saw an engine that had met with a peculiar accident. The engine was a small tank engine of the double-ended variety, used for light switching. She broke off both main drivers at the same instant. The engine was moving slowly at the time, and little other damage was done. The driving axle was broken off square and clean just even with the outside of driving box. It often happens that one side breaks, but seldom both at the same time. The axle was one of the kind where the wheel fit is much larger than the bearing.

Jim Skeevers Takes an Object Lesson Himself—Tool Grinder and Oil Economy—A Visit from the Old Man.

Jim Skeevers had been general foreman of the main shops just one month to a day when the general manager came up to see what was going on. He is quite interested in Skeevers' way of doing things.

Skeevers and the G. M. walked through the shop.

"I can't see much improvement, Mr. Skeevers," said he, "'pears to me things are going along at about the same old jog, devilish slow. I kinder looked for some reforms by this time, one of your what-de-call-'ems—oh, object lessons."

"Object lessons are not all of one kind, nor is the same one perceptible to all men. I have used a big one on myself since I came here, and it's done the road lots of good and saved some money."

"How's that?"

"Well, I came up here determined to make a show. I had not been in the shop two days before I had figured out ten changes in the shop, marked two or three drones for dismissal, spotted two apprentices for promotion, and contemplated changes that would cost the company some thousands of dollars. I had it all down pat, made up my mind—and dropped it all in fifteen minutes."

"What made you change your mind?"

"Your quarterly statement and a scrap of paper."

"Well, well."

"I went home that night and got mad at Sairy for tearing one of my back number copies of LOCOMOTIVE ENGINEERING to put on a closet shelf. While I was hunting for the place to patch it up I read part of an old editorial on 'What not to do'—then I read the quarterly statement in my daily paper. I made up my mind then and there to go slow. In the first place, the road is not earning anything above operating expenses and fixed charges; there is no business to *make* from; if it comes out ahead it must *save* the amount—I am going to try to save something."

"That's good, that's good; but what about the piece in the paper?"

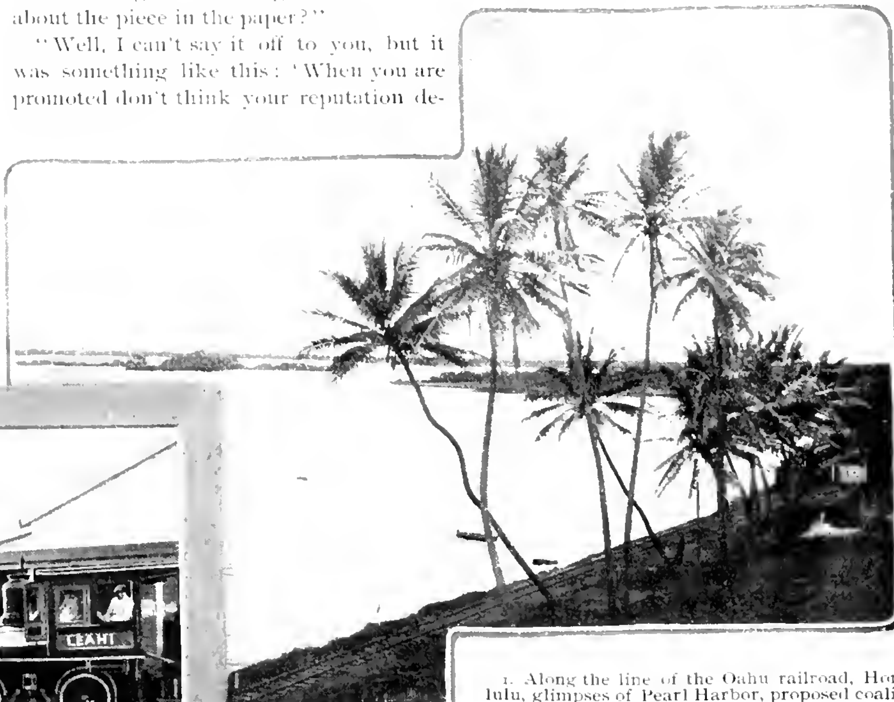
"Well, I can't say it off to you, but it was something like this: 'When you are promoted don't think your reputation depends on how many changes you can make. Look around, study conditions, cause and effect, and perhaps you will find a reason why some things are different than you would advise or expect. A fairly well organized place will run itself for a while; you simply get aboard and ride, but keep your eyes open. Never make a reform or change except for economy, safety or increased efficiency—never for the mere sake of change. A manager's success depends very much more on what he *does not* do than upon what he *does*'—and so forth. That made me drop several things I had in mind."

"Well, what?"

"I had made up my mind to dispense with the services of that white-headed old reprobate there, in the link gang. He is off three days every pay day on a drunk, he is lazy and slow and quarrelsome—spends more time in nagging apprentices than in doing work. But I found out that he's the only man in the place that can set valves. Slocum and he came from the same shop; they believed in keeping trade secrets, and out of nearly a hundred machinists, mostly made here, not one can set valves, or at least none have had experience. There's going to be a revolution over it; but if I don't have ten men setting valves here in a month my name ain't Skeevers—that change is deferred.

"I made up my mind to move that big wheel lathe to the other end of the shop, where the engine pits are, and save rolling every pair of drivers the whole length of the shop—but I found that at that end of the shop was located the out-of-date fire pit for heating tires, and most of the wheels have to go up there, anyway. I was for moving the fire pit, but found out that it affected our insurance rate—that old wooden car shop is so near. I'll rig up an oil or gas burner and take those tires off in the shop pretty soon; then will be the time to move the lathe and save hauling wheels so far.

"That's only a sample. I have in hand now a little change that I figure would increase our capacity at least a third; it won't cost a cent, but I expect it will be



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1. Along the line of the Oahu railroad, Honolulu, glimpses of Pearl Harbor, proposed coaling station of the U. S. 2. Eua plantation, output of sugar mill, 8,000 tons. 3. Moanolua, on line of Oahu road.

VIEWS IN HONOLULU.

hard to bring about—no precedent for it."

"Damn the precedent; if it don't cost anything, let's have it. What is it, anyway?"

"You would have gotten a letter about it from our general master mechanic before now, but you know he has gone East on account of a death in the family."

"Well, you explain what *you* want; maybe John won't recommend just what you do. I want to know which is best."

"What would you say if I asked for one new tool to cost, say, twelve hundred dollars?"

"Under the circumstances, Mr. Skeevers, I'd have to——"

"You'd cut it off the requisition; that's what I thought. You are like all other managers. You don't want any money spent for betterment in times like these. Well, suppose I asked for twenty-five more machinists; we need 'em and——"

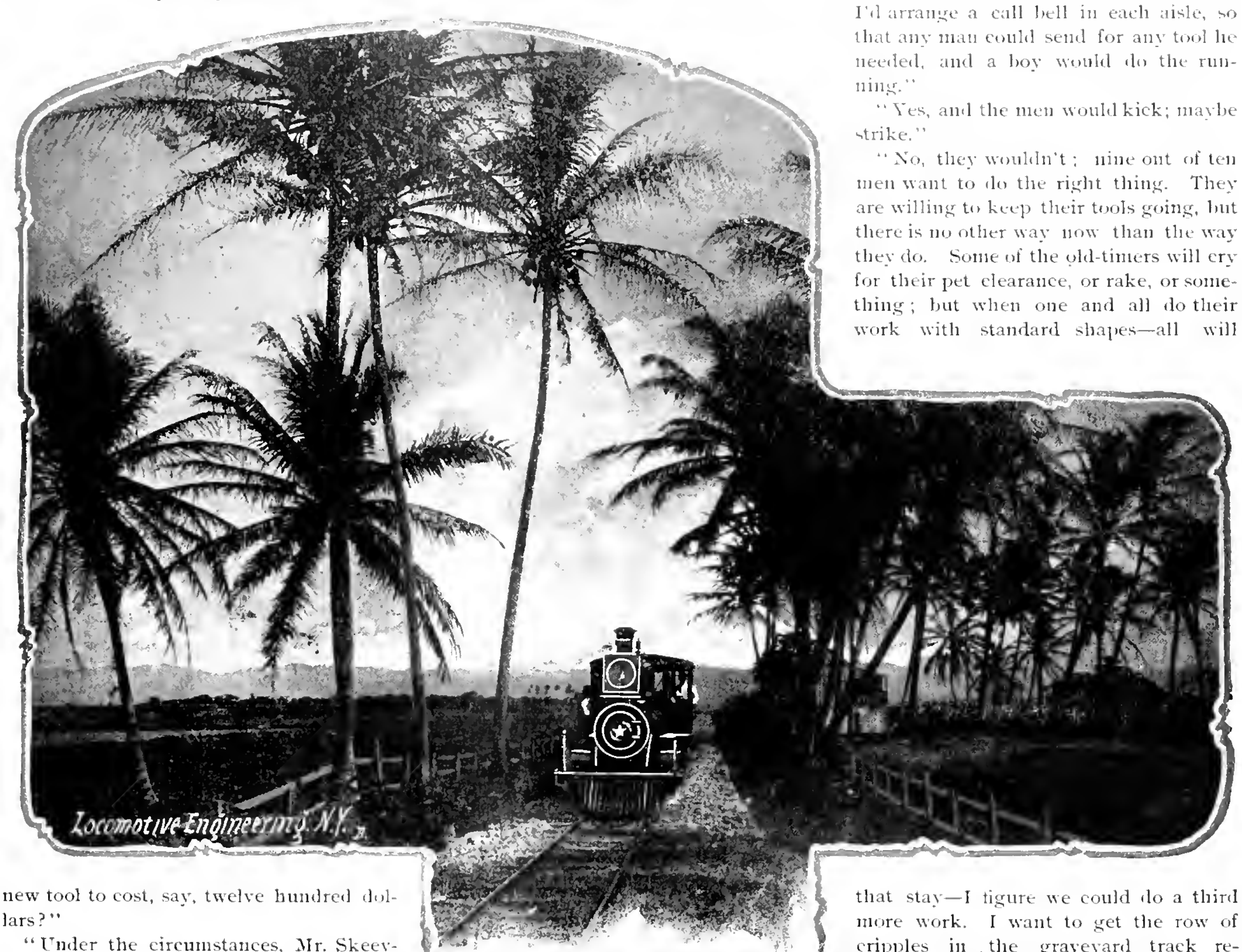
"Now, Skeevers, you know we can't think of it for a minute."

"Yes, I know. You and the directors look at the pay-roll when you want to cut down. You won't buy a new tool now, but I have a plan to get the new tool and the extra men without expense—listen:

"This road hasn't bought a new tool in ten years; but the shop management had to have some, so they made 'em. They ain't so good as boughten tools and really cost more, but they did not appear in the requisitions nor in the pay-roll—all charged to repairs.

"The manager before you encouraged the plan of 'making things ourselves,' and when this shop was equipped they bought a shafting lathe and a pulley lathe—there they are. We can't use either of them ten days a year on our own work, and if it wasn't for doing outside work for Davis they'd be still most of the time. Davis needs those tools and is willing to pay a fair price for 'em. I want to sell 'em both and buy a tool grinder."

"What's the matter with the grindstone



RAILROADING IN HAWAII—A COCOANUT GROVE.

and all them emery wheels around the place?—seems to me a tool grinder is a refinement for manufacturing places."

"Just come up into my office. There, now, you see we are in the center of the shop and six feet above the floor. You can see every tool. Now, look down that double line of lathes—how many are idle?"

"One, two, three, four—seven. Seven standing still! Why's that, Skeevers?"

"Well, you see one man is setting his work; that's all right. The others are idle because the men have gone to the blacksmith shop to get their tools dressed, or are at the stone grinding them. If I had a Sellers grinder I'd stop every man from going to the blacksmith for peculiar shapes and temper. I'd stop high pay men from standing around the grindstone, and we would buy but six sizes of steel instead of seventeen. I'd put that grinder in the tool room; one good man would grind every tool in the shop for lathes, planers, shapers, drill presses, etc., and there would be no pet shapes or pet tempers."

"Yes; but the men would stop their tools and go to the tool room for 'em."

"No, they wouldn't. I'd have two sets of tools delivered to each man every day. I'd arrange a call bell in each aisle, so that any man could send for any tool he needed, and a boy would do the running."

"Yes, and the men would kick; maybe strike."

"No, they wouldn't; nine out of ten men want to do the right thing. They are willing to keep their tools going, but there is no other way now than the way they do. Some of the old-timers will cry for their pet clearance, or rake, or something; but when one and all do their work with standard shapes—all will that stay—I figure we could do a third more work. I want to get the row of cripples in the graveyard track reduced; but with twenty per cent. of the men off and the rest working eight hours, five days a week, it's slow. We've got to save time and expense somewhere, and I don't know how to do it any easier. Do you?"

"Say, Skeevers, have you got a telephone?"

"Yes."

"Ask Davis what he'll give, spot cash, for them tools."

Davis named a price, Skeevers repeated it to the "old man," and he replied:

"Take him up and tell him to come and get 'em right off. Gimme that address and what you want and I'll telegraph for the tool grinder to-night. You had an object lesson, as you call 'em, on tap, after all. Well, I must be goin'. Let me know how the grinder goes. I'll send an order for you to deliver them tools to Davis.

That'll keep you straight with John. Oh! by thunder! I almost forgot what I came up for. Got a notice from the engineers that the grief committee was going to call on me to-morrow about Murray's case—what do you know about it?"

"Nothing officially, but I do know what he was suspended for, and have an opinion on the decision, for all that. I'm not representing the department now, mind you, but speaking as James Skeevers to the general manager. Jack Murray is as good an engineer as you have; he burned off an eccentric on the '18' last week and cut a driving axle. I heard he got thirty days."

"What made him let 'em get hot?"

"Economy of oil for the mechanical department on one side and an ambition of the management to run an Empire State express on a sand-ballast road."

"Economy of oil, hey; some of these fellers use too much oil—altogether too much."

"Yes, sir. Economy—so-called—made Jack try to keep inside his limit. His engine was new and snug, and the time fast. Allow me to observe, perhaps you never thought of it, but did it ever occur to you that it was impossible to *use* too much oil on a locomotive?"

"Great Scott! man, there's enough on the platform down at the depot to run the road a week!"

"Ah! but that was not *used*, it was wasted. All the oil you can use is better for the engine and more economical for the road; but oil on the outside is wasted money. Every bearing ought to be *flooded* with oil at some part of its movement."

"Maybe that's so, but everybody is saving oil, and we are using more than double what some of our neighbors were. I started that oil-saving scheme myself."

"I know it; it's the style, and we must be in style, cost what it may. We did *waste* too much oil, and some of it needed saving; but the road would have been money in pocket if there had never been any row made about it. A little quiet work by a live traveling engineer would have cut down the *waste*—for, as I said, the more you *use* the better.

"Did it ever occur to you, sir," continued Skeevers, "that you could save more money in a minute by watching the coal pile than you could save in a week by measuring out the oil by the thimbleful? I was looking the matter up last night. Our performance sheet—awful lot of guessing, by the way—shows that of the three men on the flyer, Barney Conners is the slickest man on oil, then comes Murray, then Sandy Macdonald. Sandy used over twice as much oil last month as Barney did—probably didn't steal any—but he ran the same train the same number of trips with nineteen less tons of coal. Let's see. You count coal worth three dollars on the engine—three times nineteen is fifty-seven—now, which of these two men are the best for the company?"

"No two ways of looking at that, Skeevers."

"Yet the head of this department put up Barney's name as the most economical runner on the road, and gave him a nickel-plated oil can—with Globe sights on it. It was such a reputation that Murray coveted, and that cost us the use of the '18' for eight days and $110 for repairs. Sandy is making double time now, and you can bet he won't get anything hot for the want of oil—he wastes some, never does know when a cup is full until it runs over, but he can be cured of that."

"Then, if you was me, you'd put Murray back to work?"

"Yes, and pay him for the time he has lost."

"I don't know about that."

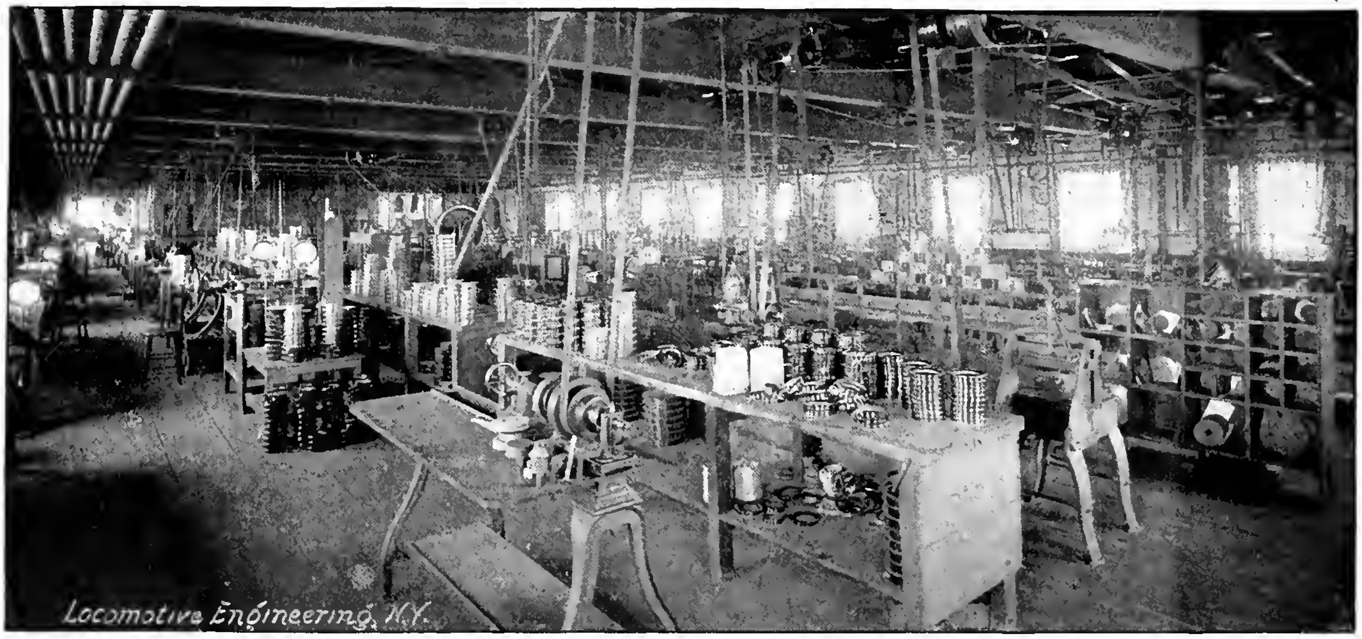
"Well, the man is either to blame or not to blame. If he is blameless, he deserves his full pay; if to blame, let him stay off his thirty days."

"Well, you send him out on his run. I guess you're right."

"Thanks, for Murray; but you think about that coal saving, and for the Lord's sake let up on the oil famine, or we'll have the graveyard so full of engines with cut bearings, broken eccentrics and burnt pins that we'll have to borrow power to haul our mail trains. Goodbye, sir."

Model Shops.

The interiors of shops shown herewith illustrate the appearance of the Ashcroft Manufacturing Co.'s steam gage factory and that of the consolidated safety valve shop, both of them being at Bridgeport, Conn. These shops are both fitted up with an eye to producing first-class finished articles at the least cost, and no expense was spared in equipping the establishments with the best special machinery that could be designed for the purpose. The shops throughout are models of neatness, and everything possible is done for the health and comfort of the workmen. When one watches the great number of steam gages and safety valves finished in these shops every day, the wonder grows as to what can be done with them all. It is an excellent object-lesson about the multitude of steam boilers required on this continent for power and heating purposes. But the volume of the output is not the only thing that will strike a mechanic visiting these shops. The fine material employed and the accurate finish of all the work, from the largest casting to the smallest pin, is something to excite admiration. The chief office of both the companies is at 111 Liberty street, New York.



STEAM GAGE SHOPS OF THE ASHCROFT MANUFACTURING CO., BRIDGEPORT, CONN.

Car Lubrication.

BY B. HASKELL.

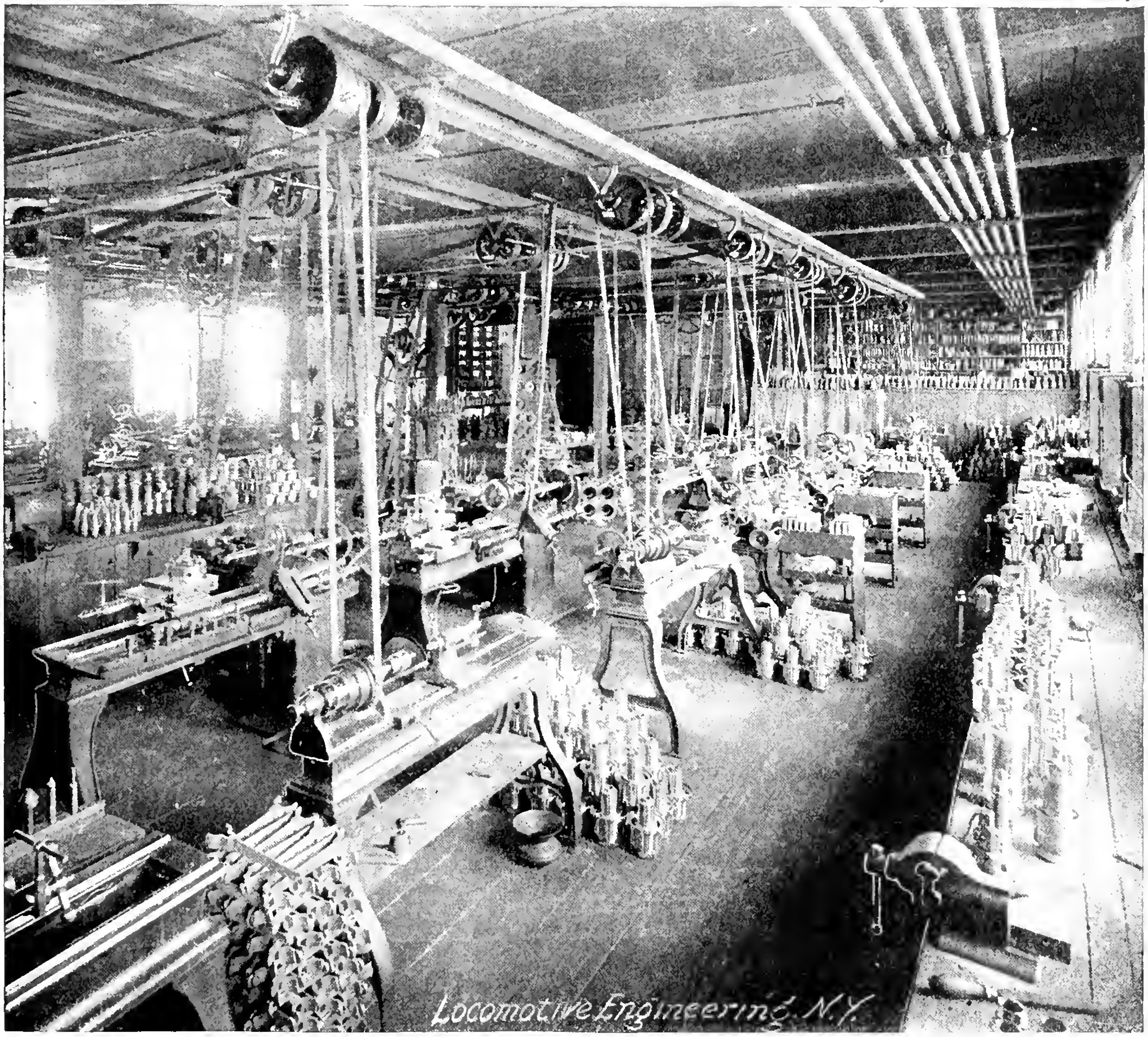
What can be more annoying to a general manager, or general superintendent, when looking over daily reports of passenger train movements, to find that some of them have been delayed by hot boxes? A delay of this nature will cause greater disgust than a delay from almost any other cause. Who can blame them for feeling that way with such reports before them? They are enough to disgust anyone.

I have given the matter of car lubrication considerable attention and study, and will try and give the result of my investigations, as they may be of benefit to some of your readers.

Michigan, as most every one knows, is a very sandy State; and I have found that the most important points to be attended to, in order to secure freedom from hot boxes, is good box covers and dust guards. If you do not have these, sand will sift into the boxes, and no matter what kind of oil or waste is used, you will not get good results. The M. C. B. standard cover, I consider a poor one; they cannot be made and applied to a box without leaving an opening on top, where sand will enter, when picked up and swirled around, and get into every little corner and opening. What cars give less trouble than Pullman or Wagner cars? They use a Fletcher, or similar cover, and I believe it the best one in use to-day for keeping the sand out. The cover seat on the boxes should be planed to insure a tight joint. While this is looked upon by some as a needless expense, it nevertheless pays.

Another point that should be watched in connection with covers, and that is the liability of weakening the spring on the Fletcher covers by pulling cover away from seat more than is necessary when opening box. Car inspectors are liable to do this, and should be warned against it, as it reduces the power of the spring to hold cover to seat. The dust guard should receive more attention than is usually given it. A glance at the wheel will tell its condition. The absence of oil on a wheel indicates good condition.

An examination of a lot of brasses removed from passenger cars revealed the fact that about 75 per cent. of them were worn most at back end. While there are other causes for this, defective dust guards are responsible for most of it. This has the same effect on the journals—wearing them most at back end. There is considerable room for improvement in this matter of dust guards. The perfect dust guard has not yet been invented, to my knowledge. Wooden and fiber dust guards wear quickly, and after a little wear they are of very little protection. What is needed is a dust guard of some material not susceptible to the wear of the revolving axle. The best guard I know of is one made of wood



Pop Valve Shop of the Consolidated Valve Company.

* Superintendent of Motive Power, Chicago & West Michigan and Detroit, Lansing & Northern roads, Grand Rapids, Mich.

with strips of rawhide fastened in a recess around journal opening in such a manner that the rawhide instead of the wood, comes in contact with the axle. The rawhide will resist wear better than any other material I know of.

Another important item is that of plugging the dust-guard pocket after guard is applied. The dust-guard pocket cannot be cast sufficiently perfect to have guard fit close to the walls. This will allow dust to enter pocket and work its way to journal, the evil effects of which will make itself know by excessive wear of bearing and journal. This can be stopped by plugging opening with a light piece of wood. The plugging of the opening to this pocket, in connection with a tight cover, will prevent sand entering box, except through dust guard, and insures a good running box as far as sand is concerned.

The M. C. B. Committee on lubrication, in their report for 1894, give oil as the first and most important feature. I consider the first and most important feature to be the box. Having the wheels, the box is the next step, and is the foundation for all other parts, and if not perfect, no lubricant, no matter how expensive, will give good results. It is a good plan, I think, to chill the jaw seats on boxes as well as the jaw face, as it prevents excessive wear to jaw flange on box. When they are not chilled, the wear caused by travel of box up and down in jaws is considerable, and allows box to cant, where there is a tendency to do so, by reason of uneven wear of journal bearing. The curved back of wedge is supposed to overcome evil effects from box canting, but does not always do it. The truck, of course, should receive close inspection and adjustment when in repair shops, as they generally get there only once a year, and the adjustment should be perfect at that time. Frame plates, I find, do not prevent trucks from becoming "diamonded," and when they are in this shape, the results to journal are bad as well as to wheel flanges. The equalizers should be closely inspected, for if the face of spring seat and box seat are not parallel, evil results will follow. Where the wear on back end of brass is excessive, you can look for a defect in equalizer or truck frame, if it is not caused by sand. As the wood in truck frame shrinks, the frame becomes loose and sags, which throws jaws out at the bottom resulting in bearing wearing most at back end. I have sometimes thought that a ball bearing between box and equalizer would be a good plan, as there would then be very little chance for equalizer to cant the box.

According to my idea, the next part to be considered is the journal bearing. A railroad company can get journal bearings at most any price they wish to pay. It is false economy to get low-priced bearings, as the expense of operating with poor bearings will cost much more than is saved in first cost, as the quality is governed by the price. Good journal bearings can be easily procured if a railroad company is disposed to pay for them. A cheap bearing is an expensive one. Take a look at a month's collection of scrap bearings. If a road is having trouble with hot boxes the scrap journal bearings will generally tell the cause. If you find a quantity of bearings with plenty of metal left in crown and *evenly* worn it denotes poor bearing or poor oil. If they are mostly worn at one end, look after trucks and boxes. I claim that very few hot boxes are caused by *lack* of oil. An examination of a hot box just before it catches fire will almost invariably show oil boiling in the box. There are exceptions to this, but they are few. Oils are the same as brasses. Good oils can be procured if the railroad company wishes to pay for them. Cheap oils are a source of more "grief" to railroad officials than any other material bought.

Passenger and freight cars should be oiled for from 10 to 12 cents per 1,000 miles, with good oil, even if it costs from 18 to 20 cents per gallon. Cheaper oil can be bought, lessening the first cost, but a reduction in mileage per pint will follow, which increases cost per 1,000 miles. Cheap oil and excessive use do not help matters out. Only so much oil can be got into a box. That which runs out through dust guard and front of box is a dead loss and does not help lubrication any, as it lubricates nothing. Refer to M. C. B. report for 1894, page 253, and you will find the statement that with but four exceptions, the "use of special cooling compounds is confined to the roads using a cheap grade of oil." This is a poor recommendation for cheap oils. If the cost of cooling compounds should be added to cost of oils (which it should be), it might be found that cheap oils did not lubricate as cheap as some parties would try and make us believe. Special cooling compounds are not needed with good oils and perfect equipment. Good oils save bearings, which is an important item. Good waste is needed to get good results and cool-running cars. A good wool waste with cocoanut fiber mixed with it is the best packing known. There is, I believe, an exclusive fibrous packing on the market, which I understand gives good results. Fibrous wool packing, in a tight box, should last for from nine to twelve months without addition. All it requires is loosening up and turning over about once every sixty days. The cocoanut fiber retains its stiffness even while in oil, and keeps the packing well expanded. It will not pack of its own accord, and can only get in that condition when it is forced by car oilers' *packing iron*. This instrument is correctly named, and is the worst contrivance any car oiler can use. All he *can* do with it is to pack the waste so tight oil will not feed through it. This same packing iron causes more hot boxes than anything I know of. The car oiler forces it down under the packing and thinks he is going to raise and loosen the packing by prying it up, while in reality he forces it to the back part of box and packs it there. *This* is another cause for journals and bearings wearing more at the back end. Packing irons should all be sent to the blacksmith shop and made into hooks that can be used for loosening packing by hooking into it and pulling it up, instead of trying to pry it up.

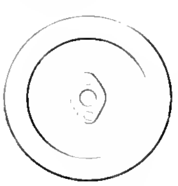
At one point on this system there was being used about 300 gallons of car oil per month. The master mechanic and myself went there and looked over the cars and found them packed too tight. We took a train and told the inspector to go over it and show us what he thought each box needed. He pushed his *packing iron* into most of them and said "oil." The master mechanic took possession of the oil can and packing iron; car inspector was given a pail of saturated waste and a packing hook, and we had him pull the old packing out, loosen it up and put it back in the boxes, keeping out what we found dirty and dry. We only oiled three boxes, and when we got through we had three pails of good saturated waste instead of two. There was one hot box on this train after this was done, and that was caused by bad journal. At this point there is now being used from 7 to 12 gallons of car oil per month instead of 300 gallons, and there are less hot boxes.

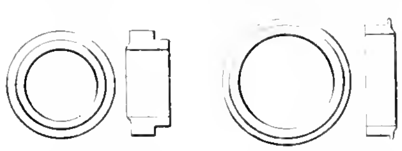
Another bad leak is caused by giving trainmen oil. Where this is done, it is safe to say that the trainmen use more oil than car oilers. There is no need of giving clear oil to train crews. Give them good saturated waste, and educate the inspectors to care for boxes in such way that trainmen will not have occasion to use it. Cars lying on sidings for a long time away from inspectors, boxes being robbed of packing to kindle fires, cars over-loaded, and cars with small journals will keep trainmen busy enough.

Care should be taken in the preparation of saturated waste. It is a good plan to dampen the waste with water before putting it in oil tank. This expands it and it will not absorb as much oil. The oil should be thinned before waste is applied. I do this by having a coil of pipes around inside of tank using just enough steam to thin the oil well. I keep it in this condition for a while, and then shut off steam and let it soak for about twenty-four hours. It is then heated again to allow surplus oil to drain off. Oil and waste prepared in this way is all trainmen and most inspectors need, but it should not be furnished in such large quantities that it will be in stock for a long while, as the oil will then evaporate. Some objections to this plan will probably be made by some transportation officers and trainmen, but after this method has been in effect awhile, if properly worked out, all will have to acknowledge it to be the best plan. I think it is safe to say that half the oil used by trainmen on a hot box runs into the ground. They generally use it to cool the box. That which runs down on the ground

represents so much money thrown away. Oil is only needed at terminal points, and not at all interchange points. Saturated waste is all that is necessary at most interchange points. If an inspector uses clear oil in a box filled with waste, what is in the box? Nothing but oil and waste. This can be much better prepared at the mixing tank than it can be by inspectors, and I believe it is the best plan, when it is found that packing is dry, to remove it and add fresh mixed packing, saving the old for remixing.

This plan may be impracticable at terminals, but it can be followed at a great many points on freight cars packed with cotton waste. On passenger cars that get regular daily attention, the addition of oil is the best plan, as the extra care and attention this class of cars get should prevent waste from getting dry. This plan, in addition to close inspection of trucks, boxes and covers has reduced the cost of car lubrication on this system from about 23.3 cents per thousand miles for the first six months in 1894 to 12 cents per thousand miles for the last six months. It has reduced the number of hot boxes to three or four per month, and results in a considerable saving in journal bearings, axles and waste, to say nothing about the annoyance of delays. This has been done with what is by some considered expensive oil, with which we made 194½ miles per pint during the last six months of 1894, including both passenger and freight service. This mileage cannot be made with cheap oils. Our passenger cars run from Grand Rapids to Chicago and return, 366 miles; Grand Rapids to Detroit and return, 304 miles; and from Grand Rapids to Petoskey and return, 452 miles, and are only oiled at Grand Rapids. The cars running to Chicago and Detroit could make greater mileage to an oiling, but I prefer to add a little oil each round trip than a larger quantity every other round trip.





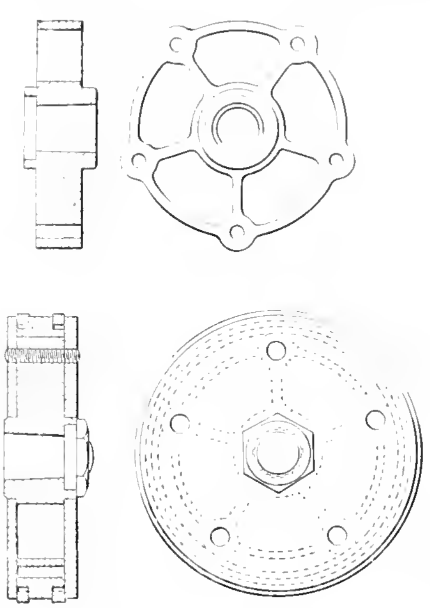
Poorly worked iron axles are often a cause for hot boxes. The liability of seams in iron axles is a point in favor of steel, but owing to the treacherousness of steel, I prefer iron well hammered and selected.

The annual report of the Massachusetts Railroad Commissioners shows that of 232 persons killed in the State last year, 136 were killed while trespassing upon railroad right of way and trains. This is about the usual proportion, and indicates the need of strict laws against trespassing on what is dangerous ground.

Cast-Steel Piston, D., S. S. & A. Railroad.

Master Mechanic J. J. Connolly, of the D., S. S. & A., is using a steel casting for piston spiders that gives him a stronger head than the old cast-iron one, and weighing about 100 pounds less for large pistons.

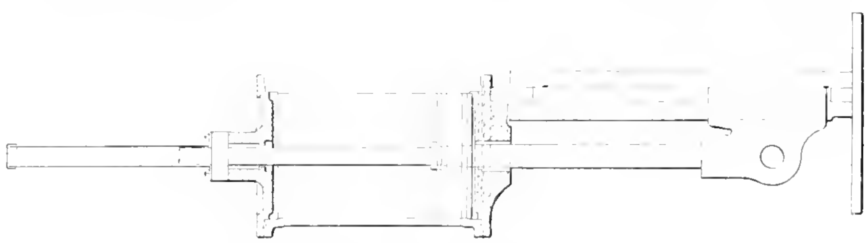
The spider is cast steel, the followers and bull ring of cast iron, the rings sprung in, as plainly shown in cut. The followers are secured to spider by studs riveted over.



There is nothing to wear out on the steel casting. It is a permanent investment and will wear on any number of followers and bull rings.

This is an important place to save weight—the reciprocating parts.

Extended Piston Rods.



The pistons of some heavy consolidation engines having shown a tendency to shoulder the cylinder at front end, and to excessive wear generally, the remedy applied is shown herewith. This is not put forward as a new thing, by any means, it having been done to doctor similar cases prior to this, when pistons were heavy and overhung. In this instance, the distance from piston packing to center of piston head is about 35 inches, and 42 inches from crosshead to same point; quite enough to cause a heavy 22-inch piston to drag badly and produce the wear noted.

A new front head, having a stuffing box for 3-inch Jerome packing, was applied, and the piston rod extended to pass through front head. The front half of the rod, 3 inches in diameter, is threaded for a nut at the piston head in the usual manner, being enlarged at the thread sufficient for the nut to slide over front half of rod freely.

Enclosing the piston is a sleeve of 3-inch gas pipe, at one end of which is a cap and at the other a flange, which secures the whole thing by means of packing gland nuts. To prevent vibration, the extreme front of sleeve is firmly secured by a clamp.

It is, perhaps, not necessary to say that excessive cylinder wear, whether due to soft iron or other causes, cannot be stopped too soon. Heavy pistons and long stroke are prolific sources of this trouble, regardless of the quality of iron in the cylinders. The extended rod can always be depended on to keep the piston somewhere in the neighborhood of center line of cylinder, equalizing the pressure per unit of area of cylinder walls, and throwing the burden of wear on the rod and rod packing, where it belongs. Rods come cheaper than cylinders.

Bless the Engineer and Fireman.

Rather a dramatic incident happened at the annual dinner of the Central Railroad Club, which was held in Buffalo a month ago. Those present were mostly railroad officers, supply men and journalists. There were a great many speeches made, and some of the speakers dilated on the hardships that railroad officers endured in their dealings with employés, and the unreasonable demands for pay that workmen were in the habit of making.

It fell to Mr. John Mackenzie, of the Nickel Plate, to talk on the modern locomotive. He briefly traced the development of the locomotive, and talked in an amusing fashion of the requirements of a good modern locomotive. After finishing his remarks on the mechanical phases of the subject, he concluded: "Now, while our attention is devoted to making the locomotive a perfect machine, do not let us forget the men who operate the engine and take our trains safely through under difficulties which no man can understand who has not been himself a locomotive engineer. In storm and shade, rushing down steep grades, rounding tortuous curves, thundering over great viaducts and flashing through intricate yards, we sit in the comfortable cars with a feeling of perfect security, because we know that reliable men are in charge of the locomotive that whirls us through space. God bless the engineer and fireman!"

The sentiment was received with thunders of applause which shook the hall.

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Loose Methods in Purchasing Coal.

When anything happens to reduce the earnings of railroads, there is an immediate demand for the curtailing of operating expenses. As the motive power department represents the largest item in the account of railroad expenditures, that is naturally regarded as the most promising field in which retrenchment can be made. As wages, which forms the heaviest item in motive power expenses, cannot be reduced without risk of an expensive conflict, efforts are nearly always made to effect saving in the use of oil and fuel. The latter account is a very heavy one, and intelligent officers understand that the saving of a pound or two of coal per car mile will aggregate a large sum at the end of the year. If this reduction of the quantity used can be brought about by increased care and skill in firing, it is pure gain. Consequently every season of depression brings forth a revival in the demand for greater skill in firing and for increased economy in the use of fuel. This revival has been in active operation during the last eighteen months, and it has no doubt resulted in important savings, but there yet remain vast possibilities for increasing the useful work that may be obtained from every pound of coal consumed in locomotive fireboxes.

When the demand for economy comes round, the attention of those interested in reducing the cost of fuel bills is at once directed to the enginemen. The engineer is instructed to use the steam expansively at all times when it can possibly be done, and the fireman is urged to fire according to the most scientific methods. Traveling engineers are egged on to extraordinary vigilance in seeing that the enginemen do their very best, and all officers responsible for the care of the motive power are kept on the rack to make sure that the efforts toward saving do not languish. Keeping the men up to their work is productive of important economies, but it does not by any means cover all the possibilities of saving.

A paper read by Mr. William Forsyth before the Western Railway Club, has brought into prominence a phase of the fuel-saving question which has been greatly neglected by those connected with the purchase of fuel. That is, the great difference in calorific efficiency of coal purchased by railroad companies, and the too loose methods usually followed in the selection of coal.

"Coals present," says the author of this paper, "a remarkable example of a great staple whose market values are arbitrary. Inferior coals should not command the same price as superior coals in the same market. Fuels do not take their standing in the market from constituent units. Iron masters buy iron ore by the percentage of iron they contain, and the same is true of copper, lead and silver ores. The principal reason why coal is not put on a similar basis is the difficulty of getting an average sample, and because laboratory methods are not more generally used."

This is a strange state of affairs and it is too true. We know of no other article purchased where quality has so little influence on price.

There are several methods of determining the heat value of coal that any intelligent man can learn in a few hours. They are not expensive or troublesome to carry out, yet very few railroad companies, except those having laboratories, do anything to ascertain the quality of the coal purchased. One ton of coal is regarded as being about as good as a ton of any other coal, and the same price is paid, although one may have 25 per cent. more heating efficiency than the other.

Very exhaustive tests have been made in the laboratory at Aurora to demonstrate the heating value of coals used by the company, and a highly valuable record has been compiled. Streator coal was taken as standard, the efficiency being reckoned as 100. Among the Illinois coals tested some went as high as 114, while others were as low as 77. The practical difference in the value of these extremes of quality of coal is that the good coal will evaporate almost one-third more water than the inferior coal. As far as we can learn, the selling price of these two qualities of coal is about the same. Any inventor who has a device that promises to save 10 per cent. in the quantity of fuel used by locomotives is certain of a patient hearing by the head of the mechanical department, and laborious tests will be undertaken to find out if the improvement is genuine. Most of the men at the head of motive power departments will complicate their engines and undertake to keep troublesome attachments in order, if they can only succeed in reducing the cost of fuel a cent or two per engine mile; but here is coal that is 33 per cent. better than the other, and yet it is safe to say that many railroad companies are using the inferior coal and paying the same price that the finer quality would cost.

We do not know of any office which controls expenditure of money that is operated so blindly as that controlling the purchase of coal. Knowledge concerning the quality of coal is not considered requisite in those who perform the responsible work of ordering the fuel supply. On many of our largest roads there is no intelligent system followed in ordering coal. Cheapness in first cost per ton is generally the first consideration, and there are not any others that count. One order will consist of hard, slow-burning coal that will not make sufficient steam unless the locomotive has a sharp-cutting exhaust. The next order will bring to the chutes a friable free-burning coal that pours through the tubes and out of the stack when a sharp blast is employed. As the men running the locomotives learn by sad experience that a nozzle small enough to cut the fire of the slow-burning coal is necessary, they take care to see that their engines have nozzles adapted to burning the most refractory coal furnished. The consequence of this condition of affairs is that the locomotives have nozzles too small for free-burning coal and great waste goes on when that quality of fuel is supplied. A similar process of waste results from using one day coal that has a high evaporative power, and the next day coal of an inferior quality. The draft appliances must be adjusted to suit the inferior coal, with the result that a large proportion of the good coal is wasted because it is not burned under proper conditions.

We do not think that any reform could be carried out on our railroads which would profit the companies so directly as an intelligent reorganization and improvement of the parties dealing with the purchase of fuel. They ought to make quality the first consideration in the purchase of coal, and the price should be based upon the quality of the article supplied. To follow out this policy, the coal should be tested systematically, a work which could be carried out at very small expense. Methods of testing the quality of the coal having been introduced, every effort should be made to keep the coal at the various coal stations of nearly uniform quality. If this were done the coal bills would be materially reduced, the trains would not be so often late on account of badly steaming engines, and the need for repairs to fireboxes would be diminished. And the fact should be borne in mind, that in these days of fast heavy trains, with all kinds of auxiliary drains on the locomotive boiler, the best quality of coal is the cheapest. The best way to secure sufficient grate area for slow combustion is the burning of first-class coal.

The Fuel Record Farce.

Measurements are not now made in the mechanic arts by "finger-lengths," "axe-handles," "corn-rows" or "hand-spans." Railroads do not order ties by the "wagon-load," machine tools by the "cargo" or putty by the "chunk."

But they do buy coal by nearly as uncertain a standard as any of the above, and charge it to their engines absolutely and entirely by guess. Worse than that, they require the guesser to guess wrong!

Knowing this, as every thinking motive power official does know it, it must be amusing to read over each other's precise statements about burning 41.019 pounds of coal per train mile, etc. It's a roaring farce, and has had the longest run of any play on record.

To say nothing about the different values of coal, the way it is given out to engines is absolutely guess-work on ninety-nine roads in a hundred. About this same proportion charge up all coal they pay for to the engines—average the shortage to them—and then with perfectly sober faces make out their hair-splitting performance sheets, exchange them, and send one to the general office. Then they must laugh—all to themselves.

Measurement of coal is only a fairly approximate way of guessing—the size of the pieces of coal alone will make a difference in quantity of at least 25 per cent.

Leaving the filling of chutes or buckets to the shovelers, and requiring them to account for all the coal bought for their station, is a direct order to falsify their reports, opens the door to favoritism, bribery and, above all, utter inaccuracy.

No one handles desirable merchandise in open cars, subject to accident, stealing and deterioration, without a certain percentage of shrinkage—which is always taken into account as loss—except when a railroad buys coal.

"Company coal" is free for all, from the mine to the firebox door. Thousands of small fires are burning to-day along every railroad on the continent with fuel not accounted for to the company, except in its being charged up to its locomotives.

There is only one fair, honest way to measure the coal used on locomotives, and that is to weigh it—not in the chute or on cars, but on the tender. If the company buys more coal than it gets on the chutes, let those responsible find the leak and try to check it—it can never be entirely stopped—but it should be accounted for where it belongs; which is not where it never was—on the tender.

At outlying stations handling little fuel this may not be entirely practicable, especially where coal is taken on the main track. But at all terminals it is easily possible.

A track scale is not an expensive investment at each division terminal; by locating one in the chute track it is an easy matter to weigh the tender as the engine is moved to the chute and again when it returns, and by this means the actual amount of fuel received is recorded. The scale man is where he can be watched—and changed, if needs be. One man familiar with the work does all the charging of coal; there are no tickets and no guess-work.

Burnt offerings should be made of every man caught stealing fuel, giving or taking bribes or showing favors—the truth is wanted and nothing else.

Premiums are right in one sense and encourage economy—perhaps are the best way to get results quickly—but the system is the mother of petty rogues.

Sober Christians vie with their Pagan brothers to get more coal than is charged to their engines—for the sake of the premiums which the company pays and, they think, can afford.

There is one road in America that weighs its coal, but not on the tender, and on one division, at least, pays a coal premium.

Not long since the writer was present when an engine took coal; it was in the night; the engineer reached in his pocket and handed something to the fireman, who stepped to the left gangway and transferred it to a man on the ground. Questioning the fireman later, he said, confidentially, that the article given was "two beers," and, lowering his voice, he added, by way of explanation, "we get a coal premium."

That might be called dishonest, but it's a petty five-cent business beside the wholesale dishonesty the men know is practiced in dealing out coal to them.

A pound of coal saved for every train mile will amount to a dividend on most roads. How can it be saved? First by interesting the engineer and fireman; second, by watching the distributing machinery; and thirdly, by removing all temptation to steal or give "short" tickets.

The saving to the railroad in the coal actually burned on the engines will be considerable, but it will be more in the saving that will eventually take place between the mine and the coal chute. Just as soon as the management finds out where the greatest loss is, they will set to work to stop leaks instead of jumping upon the head of the mechanical department for burning more pounds and hundredths of pounds per mile than his neighbor—and whose only remedy is to in turn jump upon his enginemen.

Many roads are already rating their train loads by the ton instead of by the car—a "piece of chalk" measurement long a standard. This practice will eventually become universal, and the coal burned "per ton per mile" will be the unit—and a closer record can be kept, but not if it is guessed at.

Every locomotive should be allowed so much coal per mile to haul itself and tender, and be charged with what it burns to haul so many tons so many miles—not so many "cars," and not the amount of coal bought.

In Europe, engine mileage is counted only when the engine is pulling a load. Miles made by light engines are charged up as "unproductive engine miles," and to this is charged time for switching, standing with banked fires, etc. Is not this a desirable thing to do where it is intended to find out what is actually done by the locomotive?

Every railroad officer in the land knows that the great item of expense is fuel; by painstaking care more money can be saved here than any other place, yet none can deny that there is general neglect, wholesale guessing, and a lot of fine figuring, based on nothing at all, in our fuel accounts. Reform is not difficult. Means of measuring the actual amount of coal put upon tenders is at hand, and not expensive, and results are certain. Why is such slop-shop work tolerated? Is it simply because railroads have kept their fuel account by guess-work from the start? Or does the average official think it will make him more work and trouble?

We are inclined to the belief that the development of our railroads and our rolling stock has kept the responsible heads of railroads from bothering with details; that we have reached that period of development when it becomes necessary to go over what we have and improve it, and that the great, golden opportunity lies in the coal pile.

The management that makes the first reform in coal records will not commence by sending for the performance sheets of neighboring roads, junketing trips to see coal chutes or what not, but in a resolve to do something original; to break away from all precedent and be honest to itself. Then and not till then will the "coal consumed per mile, 31.013," on the performance sheet mean anything at all but a clerkship in the office of the superintendent of motive power.

All other leaks in the running expense of locomotives are but leaky spigots; the bung is out—and it leaks coal.

Superiority of Our Locomotives.

During the last thirty years the railroads in the United States have been examples to the rest of the world in showing how cheaply freight can be transported. The locomotives that do the work of hauling freight trains have not been regarded as model machines in the economical use of steam, but when the problem has been presented of how cheaply 1,000 tons of freight can be moved 100 or 1,000 miles, the American locomotive has easily beaten all competitors. This very desirable achievement has been performed with an engine that has been considered far from perfect as a machine for converting the energy of coal into mechanical work. The defects are, however, more superficial than real.

When we compare the performance of European locomotives with those in this country, the first thing that strikes us is

the conspicuous difference in the fuel account. European locomotives have a train mile record on about half the fuel used per mile by American locomotives. Looking at the matter superficially, this appears to be conclusive evidence that our engines are wasteful in the use of fuel. People of an inquiring turn of mind at once begin to ask why is this thus? They obtain drawings and specifications of the best foreign locomotives, and compare the details with the dimensions of ours. If there is anything accurate in what has come to be a science of steam engineering, our locomotives are better proportioned than anything to be found out of the North American continent. The heating surface is much more liberal in proportion to the cylinder dimensions, the steam ports admit and release the steam with less restriction, the valve gear is designed to admit of more expansive working, and the grate area is nearly always larger. If these are not merits, the stationary and marine engines have been developed on false lines.

When a locomotive having a large boiler, generous steam ports, and liberal heating surface is reputed to be more wasteful in the use of steam than engines in which all these dimensions are more restricted, it looks on the first glance that our progress of twenty years has been a movement of retrogression. On going deeper into the subject, however, we find in our midst many old locomotives that have proportions closely approximating to those on the other side of the Atlantic, which are reported to work so much more economically than our best modern engines. When we come to compare the fuel used by our old engines with small boilers, limited grate area and restricted steam passages, with that used by our modern engines, then we find that the older types consume from 25 to 50 per cent. more fuel per unit of work done. At this point of the investigation we conclude that our designers have made no mistake, and that the people across the Atlantic must have better fuel than we have if their figures are correct.

Those who have enjoyed opportunities of watching the performance of locomotives abroad find other causes than superior coal for the low coal consumption reported. The engines do not burn so much fuel as ours because they do not perform half the work. In the course of an extended ramble over Europe, the writer watched closely the size of trains. Their prevailing lightness left no cause for surprise at the small average rate of fuel consumption required in doing the work. The heaviest freight train seen in Europe would be about equal to eighteen of our loaded cars, and the heaviest passenger train did not exceed the weight of five of our sleeping cars. But these trains, which are considered heavy on the other side, form a very small proportion of the whole of the trains run, probably not more than 5 per cent. The majority of the freight trains do not equal in weight ten of our cars, and the majority of the passengers have about five carriages, which weigh less than two of our day coaches. When the fuel consumption of our modern locomotives is figured on the basis of ton miles, it compares very favorably with that of any engine on wheels.

Slow Progress into Use of Safety Appliances.

The railroad companies in Massachusetts are much more prosperous than those of any other section at present, and the managements are nearly all enterprising beyond the average. These facts being conceded, there is reason to believe that the application of automatic brakes, automatic car couplers, and other safety appliances to freight equipment must be proceeding very slowly among the railroads in other States. The Railroad Commissioners' report for Massachusetts shows that the Vermont Central and the Concord & Montreal have 23.2 per cent. of their freight cars equipped with automatic car couplers, the Boston & Albany has 83.5 per cent. of its cars so equipped, and that the New Haven has 31.7 per cent. The other railroads in the State have very few cars equipped with automatic couplers.

The Boston & Albany has 45 per cent. of its freight cars provided with automatic brakes, but the average for six companies operating in the State is only 15.3 per cent. Throughout the whole report the Boston & Albany stands up as the best equipped and most liberally managed railroad in New England, and that really means on this continent.

Driver brakes on locomotives are very general now, 72.7 per cent. of the total locomotives in Massachussetts being now provided with them.

The depression in business has furnished a fair excuse for railroad companies going slow in the introducing of expensive improvements, such as automatic brakes and couplers, but the stockholders are few who will permit the expenditures to be made, which are necessary, if the law regulating the question of safety appliances is to be complied with. Two years ago a law was passed by Congress, which provides that after January 1, 1898, all cars used in interstate commerce must be provided with automatic couplers and end hand holds. The freight cars must have the drawbars the standard height from the rail. No trains can be run without having a sufficient number of cars equipped with air brakes, to enable the train to be controlled by the engineer. Drastic penalties are provided for violations of this law.

A great many automatic car couplers and air brakes must be purchased and applied in the next two and a half years, if the railroad companies doing interstate commerce are to be in a position to comply with the law. There is a belief that when the time comes for the law taking effect it will be extended by Congress. Those who act on this belief may find themselves sadly mistaken. If Congress should prove inexorable a good many railroads will go into receivers' hands about the beginning of 1898.

The Act of God as an Excuse for Accidents.

The railroad companies in this country are not noted for their readiness to pay claims brought against them for damages to persons in accidents, but when they find that they are morally and legally liable they seldom fight the claims in the courts. The richest railroad corporation in England has lately shown to the world a conspicuous example of a determined and unscrupulous attempt to escape its responsibility for an accident where many lives were lost and terrible injuries were inflicted to passengers, whom the company had undertaken to carry safely to their destination.

About Christmas, last year, a sanguinary accident happened on the London & Northwestern Railway, near Crewe, England, caused by a car having been blown out of a siding on to the main line, through the force of the wind. A passenger train struck the freight car, and about thirty persons were killed or severely injured. The company is now fighting the claims for damages on the ground that the accident was an act of God. If the courts can only be induced to decide that this is a good defense, there will be no more accidents that railroad companies can be held responsible for. We can think of no case where man's carelessness is so directly responsible for an accident, as where cars are so insufficiently secured in a siding that they can be blown out by the wind. If the wind is an act of God that relieves the company from responsibility, we should like to know of anything, from the breaking of inferior rails to the exploding of badly inspected boilers, that does not come under the same category.

Standard Sizes of Catalogues.

A short time ago, one of our editors wrote to Mr. G. W. Rhodes, intimating that there was no postal card now issued by the Government, of the dimensions $3\frac{1}{4} \times 6\frac{1}{8}$ inches, which is one of the standards of the M. C. B. Association. In a private letter received from Mr. Rhodes on this subject, he says that he has recommended that this size be abandoned, and in lieu of it the government size of $3\frac{1}{2} \times 5\frac{1}{2}$ inches be adopted. He adds:

"I am very glad you are taking interest in our effort to get standard sizes for railroad literature, trade catalogues, etc. We find it a great convenience in filing away papers. I think the adoption of the 9 x 12 size for your paper is a capital move. A great many of the trade circulars, however, still come of odd sizes and dimensions. Those that are not of the standard dimensions, in so far as my office is concerned, are usually consigned to the waste basket,

and I think the same will be found to apply to a good many other offices."

We have made exhaustive inquiries into this matter, and find that nearly all railroad officers are taking the same stand as Mr. Rhodes in relation to catalogues which do not conform to the M. C. B. standards. It therefore behooves those who wish to have their pamphlets kept on file to have them made according to standard sizes.

Compound Locomotives in Switzerland.

The Northwestern Railroad of Switzerland have been carrying out a system of highly practical tests to demonstrate the relative value of simple and compound locomotives. They had several simple and compound locomotives built which were of the same dimensions in all respects, except that the compounds had a large low-pressure cylinder and a starting arrangement, by which steam could be admitted direct into the low-pressure cylinder.

The simple and compound engines were run in the same kind of service for about nine months, careful records having been made of the fuel and water consumed. To make the test still more even, the crews were changed round on the engines. At the conclusion of the nine months' test, it was found that the saving of coal by the compounds amounted to about 16 per cent. The result is that the company have decided to adopt compound locomotives for freight service, and six new compound engines have been ordered.

We recommend to railroad officers who are interested in changing the rules regulating the interchange of cars, a careful study of the article in our Car Department giving the views of Mr. R. P. C. Sanderson, division superintendent of motive power of the Norfolk & Western, at Roanoke, Va., on how the proposed changes are likely to work. The article contains facts and figures, which prove, that under the proposed change, honest companies, or those whose officers act fairly and conscientiously towards interchanging roads, will be at the mercy of those that follow the opposite policy. If the existing charge for mileage of cars is adhered to, railroad companies will profit by using the cars of other roads and having as few as possible of their own.

Those concerned ought not make the radical change contemplated without thoroughly considering all the arguments pro and con. Mr. Sanderson appears to make out a strong case in favor of reforming existing rules rather than in the revolutionary movement proposed by Mr. Barr and others. The study of the paper has convinced us that changing from the existing practice to that of holding owners responsible for the repairs of their own cars, will prove a case of jumping out of the frying pan into the fire—and an intensely hot fire at that.

Newspaper editors are constantly receiving articles for publication puffing the merits of the metal aluminum, and making extravagant claims about its future importance in the construction of machinery. After having tests made of this metal, we have held that steel was much better than aluminum for many of the purposes which the friends of the latter metal said it was peculiarly adapted for. Our position has lately received support from Hiram S. Maxim, the inventor of what appears to be a successful flying machine. In describing his search for a metal that would combine lightness with strength, Mr. Maxim said that his attention was directed to aluminum. He investigated the merits of this metal and found out that it was very much inferior to steel, weight for weight.

A significant indication of how depressed business has been in the past year is found in the Massachusetts Railroad Commissioners' annual report. For ten years preceding last year, there was an average increase of 57 locomotives on the railroads of the State; last year the increase was only one. The annual increase in passenger cars was formerly 121; last year it was 63. The number of persons employed by the railroads has decreased 2,104 below the average of ten years.

BOOK REVIEW.

POCKET LIST OF RAILWAY OFFICIALS. Issued quarterly by the *Official Railway Equipment Guide*, New York. Price, $1 per annum.

The first number of this new list has been received, and we have reason to congratulate the publishers on the excellent guide to the names and addresses of railroad officials which they have gotten out. It is admirably arranged, and all the information is arranged in very convenient form. It begins with all the names of the railroads in North America, giving in columns the number of miles operated, gage of track, number of locomotives, passenger cars, freight cars and miscellaneous rolling stock. From this we learn that there are 1,281 concerns on the continent owning cars or locomotives. This is a very convenient improvement on all other official lists, since it enables one to distinguish at a glance the large from the small roads.

Next part of the "List" is devoted to the names and addresses of the principal railroad officials. This appears to be fairly correct and up to date. Then comes a finding list, with the names arranged alphabetically in columns, which is a great convenience. Besides the foregoing there is a great deal of miscellaneous information, such as headquarters of officials, particulars about railroad associations, railroad commissioners, representatives of railroad supply houses and other valuable facts. The only mistake made by the publishers of this list is that they have not cut it according to any M. C. B. standard size. The most valuable thing about it is that it comes out quarterly and is therefore nearly up to date, and is therefore a decided improvement over lists published annually. Supply men or others wishing to find the names and addresses of railroad officials should send for this list.

PERSONAL.

Mr. James P. Harris has been appointed advertising agent of the Plant system, with headquarters at Savannah, Ga.

Mr. H. Taylor has been appointed trainmaster of the northern division of the Mexican National, in place of Mr. F. W. Weeks, resigned.

Mr. N. S. Kimball, master mechanic of the Chicago, Milwaukee & St. Paul, at Green Bay, Wis., is reported to have tendered his resignation.

Mr. L. Cass Woodman, formerly with the Denver & Rio Grande, has been appointed advertising agent of the Great Northern, with headquarters at St. Paul, Minn.

Mr. A. C. Titus has been appointed chief engineer of the Gulf & Interstate of Kansas, with headquarters at Topeka, Kan. Mr. A. H. Weatherbee is assistant engineer.

Mr. R. O. Cunebach has been promoted from the position of foreman of the Illinois Central shops, at Clinton, Ill., to be general foreman of the principal shops at Burnside, Ill.

Mr. T. A. Kuntz, who has been for some time clerk to J. V. Goode, superintendent of the Fort Worth & Denver City Railway, has been promoted to be chief clerk, *vice* C. M. Dunham, resigned.

Mr. L. W. Robinson, who has for the past five years been general superintendent of the Rochester & Pittsburgh Coal & Iron Company, has been made general manager of the company.

Mr. George A. Burt, of New York, has been appointed general manager of the Ohio River Railroad, with headquarters at Parkersburg, W. Va., in place of Mr. G. Clinton Gardner, resigned.

Mr. John Preston, formerly master mechanic of the Puebla shops of the Mexican Inter-Oceanic, has been transferred to Vera Cruz, where he has charge of the locomotive and car departments.

It is rumored in the West that Mr. W. T. Reed, formerly superintendent of motive power of the Chicago & Great Western, has been appointed superintendent of motive power of the Seaboard Air Line.

Mr. L. B. Eaton has been appointed railroad agent for the E. S. Greeley Co., New York. Mr. Eaton is a highly popular railroad supply man, with a most extensive acquaintance among railroad purchasers.

Mr. Frank Slater, who has been for years general foreman of the Chicago & Northwestern shops, at Kaukauna, Wis., has been promoted to be general foreman of the company's shops at West Chicago.

Mr. George A. Miller has been appointed acting master mechanic of the Jacksonville, St. Augustine & Indian River Railroad, in place of E. T. Silvius, resigned. Mr. Miller was formerly machine shop foreman.

Mr. E. W. Hayes has been appointed superintendent of motive power of the

Fort Worth & Denver, with headquarters at Fort Worth, Tex. Mr. Hayes has been master mechanic on the road for the last three years.

Mr. J. H. Foster, who has been superintendent of the James River division of the Chicago, Milwaukee & St. Paul since September, 1893, has been appointed superintendent of the Wisconsin Valley division of that road, with headquarters at Babcock, Wis.

Mr. E. J. Pearson has been appointed superintendent of the Missouri River and Yellowstone divisions of the Northern Pacific, with headquarters at Glendive, Mont. He has heretofore been chief engineer of the Chicago & Northern Pacific, at Chicago.

Mr. W. G. Christian, late superintendent of the South Jersey Railroad, has been appointed supervisor of the North Penn branch of the Philadelphia & Reading. He was formerly supervisor of the Lebanon Valley and East Penn branches of the same road.

Mr. Charles Blackwell has accepted a position as traveling agent for the Carpenter Steel Co., of New York. Mr. Blackwell was for several years with the Shoenberger Steel Co., Pittsburgh, and previously was superintendent of motive power of the Norfolk & Western.

Mr. Wilbert Irwin, Jr., superintendent of the Texas Midland, was killed last month by falling off a train. Mr. Irwin was for some years a division superintendent on the Chicago, Milwaukee & St. Paul, and before that was on the Southern Pacific. He was a highly popular and efficient officer.

President Garstang, of the American Railway Master Mechanics' Association, has appointed a committee, of which Mr. G. W. Rhodes is chairman, to report at next convention on the adoption of standards of paper, pamphlets, reports, etc., similar to those made standard by the M. C. B. Association.

Mr. F. D. Casanave, general superintendent of motive power of the Pennsylvania Railroad, has been sick for several months, and underwent a very painful surgical operation. His numerous friends will be pleased to learn that Mr. Casanave is rapidly recovering, and is able to be out a little when the weather is fine.

Mr. E. A. Custer, engineer of tests of the Baldwin Locomotive Works, has accepted the position of mechanical engineer for Harrison Brothers & Co., Philadelphia. Mr. Custer served his apprenticeship in the Pennsylvania shops at Altoona, and has had a highly valuable experience in engineering work. He took most of the celebrated high-speed diagrams from Baldwin locomotives.

Mr. James M. Phillips, general superintendent and master mechanic of the Kentucky Union Railway, died at Dallas, Tex., February 4th. He began his railway career in 1855, as train boy, and served successively as brakeman, baggage master, freight conductor, fireman, engineer, passenger conductor, yardmaster, master of transportation, superintendent, and general superintendent.

Mr. C. A. Moore, of the firm, Manning, Maxwell & Moore, the well-known railroad supply dealers, is president of the Montauk Club, of Brooklyn. Through the management of Mr. Moore, this club gives a dinner annually to Dr. Chauncey M. Depew, on the latter gentleman's birthday. The dinner does not take place for nearly two months, but the applications of those desiring to attend are so numerous that the greater part of the seats are already taken.

Captain R. G. Fleming, one of the best-known railroad men in the South, died towards the end of last month. He entered railway service as machinist apprentice in the machine shops of the Greenville & Columbia. After finishing his apprenticeship, he went firing for a short time, then he took the position of station agent, then conductor, rising from that to be superintendent. Lately he has been general superintendent of the Savannah, Florida & Western.

Mr. Edward J. Parkinson died at Birmingham, Mich., on February 3d, of erysipelas. He was born near Belfast, Ireland, in 1845; came out to this country when a lad and entered the service of the Grand Trunk Ry., as a boy in the mechanical department, thirty-four years ago. He has for the past twenty-seven years been in the office of Mr. Henry Roberts, mechanical superintendent of the C. & G. T. Ry., at Detroit, as chief clerk, and was a genial man of kindly disposition and widely known.

Robert Laidlaw, president of the Laidlaw-Dunn-Gordon Pump Company, of Cincinnati, was elected treasurer of the National Association of Manufacturers, which convened at Cincinnati the third week in January. Mr. Laidlaw was one of the leading spirits in organizing the association, and much of the success of the convention was due to his superior executive skill and untiring energy. The delegation was banqueted at the new plant of the Laidlaw-Dunn-Gordon Pump Company.

Mr. Bradford Dunham, the well-known Southern railroad man, has been appointed general manager of the Plant System of railways. Mr. Dunham, like a great many of the most successful Southern railroad officers, received a mechanical training. He learned the machinist trade in the shops of the Central Georgia, and after his time was finished, went into train service, rising through the grades of brakeman, conductor, train master, etc. For the last six years he has been general superintendent of the Alabama Midland.

A biographical notice of Mr. Davis, general manager of the Richmond Locomotive Works, lately appeared in the *Engineering News*, in connection with his election to be president of the Society of Mechanical Engineers. A few days after the notice was published, Mr. Davis called at the office of a friend in New York rather early, and no one was in but the office boy. He left a message for his friend, and asked the boy if he was sure of the name. "Oh, yes," said the urchin; "I shall not forget *your* name, for I have just been reading your obituary."

Mr. L. Packard, master car builder of the New York Central, at West Albany, N. Y., died last month. Mr. Packard was one of the ablest master car builders in the country, and had a wide experience. He left the Wason Manufacturing Co., where he was foreman, to become master car builder of the New York, New Haven & Hartford. Then the Baltimore & Ohio secured his services, and he was with that company for three years. He has been eleven years with the New York Central. Mr. Packard's strong point was shop management, and the ingenious methods and tools he devised for facilitating production.

Mr. William Thornburgh has been appointed general superintendent of the Columbus, Sandusky & Hocking Valley, with headquarters at Columbus, O. For several years Mr. Thornburgh has been general agent for the Butler Drawbar Attachment Co. He is a veteran railroader, and was for four years general manager of the Valley Railroad. He rose through the train department of the C., C., C. & I., and left that company to be general superintendent of the Springfield, Jackson & Pomeroy. He has a very extensive acquaintance among railroad officers and supply men, and his numerous friends will be glad to hear that he is back again into railroad service.

Mr. John B. Smith, president of the Erie & Wyoming Valley, who was one of the oldest railroad engineers in the country, died at Dunmore, Pa., in January, aged 90 years. In 1831 he entered the machine shops of the Delaware & Hudson, and served five years. He passed with different companies through the grades of draughtsman, master mechanic, superintendent of machinery, general superintendent, up to the top of the ladder. He was designer of a three-cylinder simple locomotive, which is said to be doing remarkably good work on the E. & W. V. The cranks are set at 120°, which gives a more uniform rotative effect than the way the power is applied to the ordinary locomotive. One crank axle is used.

Mr. John F. McIntosh has been appointed locomotive superintendent of the Caledonian Railway, to succeed Mr. John Lambie, deceased. Mr. McIntosh received the first part of his mechanical training on the Northwestern division, where he rose to be engine driver. He lost his right hand through an accident, and what seemed an irreparable misfortune gave him the first start on the way to a high position. On recovering, he was made locomotive inspector, which is a position similar to

that of our traveling engineer. From this he was advanced to be engine-house foreman, and he made such a conspicuous record for executive ability that he was rapidly advanced. He has been assistant locomotive superintendent for five years.

One of the most popular, enterprising and warm-hearted men in wide Iowa is Mr. John C. Broeksmit, auditor of the Burlington, Cedar Rapids & Northern, at Cedar Rapids, Ia. In the early days, when the town where he settled needed some energetic moral grease to lessen the friction and keep the wheels of progress moving, the citizens were in the habit of calling on Mr. Broeksmit for aid and counsel, and he never failed them. He lately celebrated his seventieth birthday, and the leading men in the town which he did so much to build up collected to do him honor. There were thirty invited guests present at a dinner given in honor of the occasion, and Mr. Broeksmit was presented with a handsome oak rocker with Russia leather trimmings, President C. J. Ives, of the B., C. R. & N. road, making the presentation speech. Mr. Broeksmit is one of the veterans in the railway service, having begun his railway career in 1857. In 1871 he went to Cedar Rapids as chief clerk to the auditor of the Burlington, Cedar Rapids & Minnesota, now the Burlington, Cedar Rapids & Northern, and two years later he was made auditor, which position he has held ever since.

All railroad men are familiar with the firm name Manning, Maxwell & Moore, but some of the individual members of that firm have been merely an abstraction. Eugene L. Maxwell has been comparatively unknown, but those who came in contact with him made the acquaintance of one of the warmest-hearted and most genial men they had ever met. His leading characteristic was retiring modesty. He held back from miscellaneous acquaintance through this characteristic, and it deprived many of a helpful friend, who was singularly free from thought of self in his intercourse with business acquaintances. A few days ago the writer called in Mr. Maxwell's office, and was received in a teasing, jocular style, which he assumed with what he called his fellow countrymen, and he was full of humor and animation. Words cannot express the shock we received three days after, on reading in the morning paper that Mr. Maxwell had died of apoplexy in the forty-second year of his age. He came of the wild, fighting Scotch border stock, that have made in later years as great a success in peaceful pursuits as their ancestors made with the arrow and claymore. Mr. Maxwell was born in Brooklyn, N. Y., and was educated at the Polytechnic Institute of that city. He became associated with Henry S. Manning & Co., but for the last fourteen years the firm has been Manning, Maxwell & Moore. He was president of the Pond Machine Tool Company, of Plainfield, N. J.; president of the Ashcroft Manufacturing Company, of Bridgeport, Conn.; vice-president of the Shaw Electric Crane Company, of Muskegon, Mich., and an officer or director in five or six other concerns. He was a member of the Montauk Club, of which his partner, Charles A. Moore, is president, and also a member of the Hamilton Club, the Atlantic Yacht Club, and was treasurer of the Riding and Driving Club, of Brooklyn. He was a member of the Rembrandt, Lawyers' and Engineers' Clubs, in New York.

Some Fast Runs on the C. & N. W. Road.

The Chicago & Northwestern do not hesitate to run a fast train when necessary, and they don't pick out a special fast engine for the run, either.

On January 6th, Engineer P. Pickering, with an 18 x 24 eight-wheeler, took a mail car and two baggage cars from Boone, Iowa, to the U. P. Transfer in Council Bluffs, a distance of 149.5 miles, in 179 minutes.

Stops were made for four railroad crossings, 4 minutes were lost for a hot eccentric, and 16 minutes at stations, taking water and unloading express, which, allowing 2 minutes each for the crossing stops, brings actual running time to 147 minutes.

On January 17th, Engineer Frampton, with a 19 x 24 ten-wheeler, having only a 57-inch wheel center, took the same train from Marshalltown to Boone, 51.7 miles, in 58 minutes. He lost 4 minutes at two road crossings, and 7 minutes unloading baggage, which, when deducted, brings his average speed up to 74.2 miles per hour.

Railroad Accident to a Cent.

One day not long since, an engineer on a P. R.R., Class "R" — consolidation — engine dropped a one-cent piece into the main-rod oil cup, by accident. It remained in there while the engine ran over five hundred miles, and when taken out, had a perfect ring around it, looking as if it had been rolled on. The ring is perfectly even all around, and turned over until the edges touch the face of the coin. This work was done by the coin knocking back and forth in the cup; the edge was upset. If anyone wants to increase the width of rims of cent pieces and reduce their diameter, this is the way to do it.

A correspondent says: "What is the use of spending money for papers and books for the purpose of getting information in regard to the various kinds of railroad work, when one will be suspended for five days for getting the forward trucks off at the end of a switch?" We must confess that the connection between acquiring knowledge and the getting off the track does not come home to our comprehension.

EQUIPMENT NOTES.

The Central Vermont are about to order 18 passenger cars.

The Southern Pacific are about to order 18 passenger cars.

The Chicago, Paducah & Memphis are in the market for 200 cars.

The Baltimore & Ohio Southwestern have asked for bids for 500 refrigerator cars.

The Seaboard Air Line are reported to be in the market for cars and locomotives.

The Baltimore, Chesapeake & Atlantic are said to be in the market for locomotives.

The Concord & Montreal have ordered one locomotive from Baldwin's, to be delivered by May 1st.

The car shops of the Philadelphia & Reading have been put on full working time, six days a week.

The Mt. Vernon Car Mfg. Co. have received an order from the St. Louis, Alton & Terre Haute for 75 furniture cars and 50 box cars.

The Boston & Albany have ordered twenty locomotives from Schenectady, ten eight-wheel passenger, and ten consolidation locomotives.

The Sterlingworth Railway Supply Co. have entered into a term of years contract with the Cambria Iron Co., for the exclusive manufacture of their metal brake beams.

The Baldwin Locomotive Works have adopted the Master Car Builders' sizes for sizes of paper, specifications, etc. The specifications for locomotives are printed on a form $8\frac{1}{4}$ x $10\frac{3}{4}$ inches.

The Rogers Locomotive Works have just finished four heavy consolidation engines for the Toledo, Peoria & Western. The engines have driving wheels 58 inches diameter, which is the largest size we know of for consolidation locomotives.

The Delaware, Lackawanna & Western have ordered two eight-wheel passenger engines from the Dickson Locomotive Works. They have received bids for 500 coal cars, and expect to award the contract this month. The road is very short of coal cars.

The Boston & Maine mechanical department are working on drawings for new locomotives, which will be ordered in the near future. There will be some eight-wheel passenger engines and moguls. The company are also about to order 600 freight cars.

The New York Central have ordered 3,000 box cars. Half the order has gone to the Peninsular Car Works, and the other half to the Buffalo Car Works. The cars are first-class in every particular. They will have Fox trucks, Gould couplers and Westinghouse air brakes.

The Delaware & Hudson have ordered three passenger engines from the Dickson Locomotive Works and three from Schenectady. They will all be equipped with Cory force feed lubricator and Richardson

balanced valves. These lubricators are coming into extended use and are highly popular.

The Union Tank Line are preparing drawings for a new tank car 40 feet 6 inches long. The car is a box car with two tanks and 17 feet of floor room between them. The car, light, will weigh 45,000 pounds, and when loaded the weight will be 108,000 pounds. There will be 90 of these cars built on the first order.

We have received from the A. E. Filley Manufacturing Co., New York, an illustrated catalogue of their "Defiance" improved asphalt car roof. There is no coal tar or petroleum residuum in the products from which the roof is made, and high claims are made for the strength and durability of the roof. It is highly flexible, is not affected by weather or vibration, and is easily applied to cars. The roof has been extensively used on buildings.

The Champion Iron Co., Kenton, O., are about to put upon the market an improved car coupler of the M. C. B standard form. A valuable feature about the coupler is that mechanism is provided which will prevent the coupler from falling upon the track in case that the shank breaks. There have been so many wrecks caused by couplers falling on the track, that the improvement mentioned is a strong recommendation to the coupler having that valuable feature.

The Pennsylvania Railroad are building, at Altoona, several switching engines of a new class U, with cylinders 17 x 24 inches, weighing 80,000 pounds and carried on four wheels. They are also getting out a new consolidation compound after the style of the Pittsburgh compound, which did remarkably good work when tried on the Pennsylvania. They are getting out drawings of a new fast passenger engine, which will be different in many respects from anything now used by the company.

An interesting series of tests under boilers was lately made by the National Transit Co., to ascertain exactly the water-evaporating power of various fuels. The water evaporation was calculated from 212 degrees at atmospheric pressure. One pound of coal will evaporate 10 pounds of water from 212 degrees atmospheric pressure; 1 pound of oil, 16 pounds; 1 pound of natural gas, 20 pounds. One pound of coal equals 11,225 cubic feet of natural gas, one pound of oil equals 18 cubic feet of natural gas.

The Richmond Locomotive Works have applied to their latest compound locomotive a very simple form of variable nozzle, designed by Mr. E. F. C. Davis, general manager of the works. A reduced size nozzle cut in two vertically is made to fit upon the ordinary nozzle, which is $5\frac{1}{2}$ inches in diameter. When the engine will steam with the ordinary nozzle, the two parts of the reduced one are folded back.

In Pratt & Whitney Co.'s Shops.

The Pratt & Whitney Co., Hartford, Conn., have lately received a number of orders from foreign countries for their measuring machine, and also a good many home orders which indicates a growing interest in accurate measurements. The shops are fairly busy, mostly with special tools. There has been a fair demand for their powerful milling machines, which do such work as channeling side rods at one cut. Some improvements have been made on this machine lately which will make it still more efficient.

There is a remarkably interesting thing to be seen in the measuring instrument department, under charge of Mr. George M. Bond. It is an absolutely plane surface made of hardened steel. Those who have examined the finest polished metal surfaces under powerful microscopes are aware that the surface looks as ragged as a plowed field. The surface which Mr. Bond has finished, when examined under a microscope which magnifies the diameter 150 times, is perfectly smooth and glossy. Looked at with the naked eye, the steel piece looks like a plate glass mirror.

Most railroad mechanics think that the close measurements represented by thousandths or tens of thousandths of an inch are useless refinements that are of no practical use. They are of value principally in the making of instruments for watchmaking and other fine work, but nearly all good mechanics work as closely as the $\frac{1}{1000}$ of an inch, although they may not be aware of it. Even the $\frac{1}{10000}$ of an inch can be felt by an ordinary mechanic. The measuring instrument was set to take in an accurately finished plug. The man in charge asked me to try the plug between the slides. Then he moved the gage $\frac{1}{10000}$ of an inch, and asked, Is it larger or smaller? The difference was quite perceptible, and during a variety of trials making the opening larger or smaller by the minute distance named, I had no difficulty in telling the changes correctly.

They have plugs made to fit accurately drilled holes. One plug is an exact fit, the other is $\frac{1}{1000}$ inch smaller. The difference in the fit is so apparent to the touch that a close working machinist would think that a rod bolt with the same amount of play was too loose.

Men accustomed to fine mechanical work often become surprisingly accurate in measuring by the sense of touch alone. A well known mechanical engineer visited an office in New York one day, and fell to talking about the difficulty of purchasing steel balls for bicycle work which were perfectly true. He had a pocket full of balls and a micrometer gage to prove that the balls were not true. To surprise his auditors he began rolling a ball between his fingers and then identifying by the sense of touch a flat spot. The micrometer gage proved that there was a spot about $\frac{1}{10000}$ of an inch flat at the point he indicated. The same thing was done with other balls. Two machinists who were present were not impressed with the performance as being anything extraordinary. One of them took a ball and also rolled it between his fingers and pointed out the flat spot. He did the same thing with all the other balls. The other machinist, who had never worked on very fine finishing, next tried his hand at finding the flat spots and succeeded with several of the balls. We commend this testing of balls as an amusement for young mechanics.

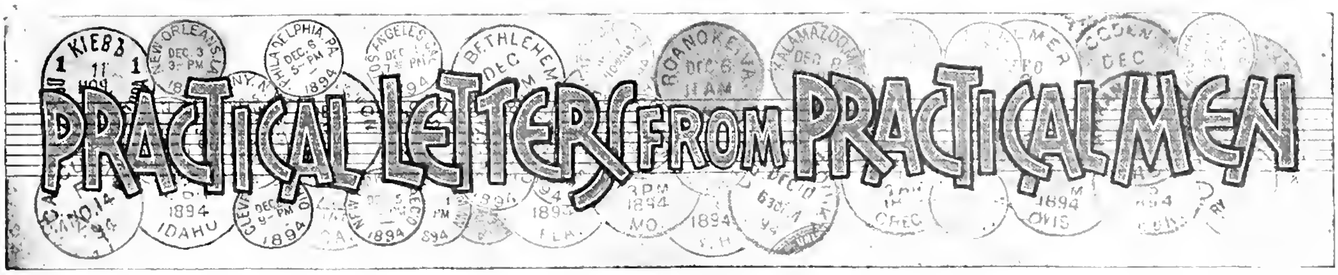
A. S.

During a recent visit to the E. Horton & Sons Co.'s works at Windsor Locks, Conn., we learned from Mr. Bailey, the president of the company, that they have been kept fairly busy, lately, with foreign orders. The Horton chuck is remarkably well known abroad, and not a few shops in Europe make very close imitations of the original designs. Imitators, however, seldom produce an article that is equal to the original, and purchasers in Europe understand this very well, hence the demand for the genuine Horton chuck. They make the lathe chuck in twenty-two sizes, beside special forms of chucks for drill presses and other purposes.

Through the labors of President Egan, of the J. A. Fay & Egan Co., of Cincinnati, and a few others, a manufacturers' association was formed, for the purpose of looking after the interests of American manufacturers. This association met in convention at Washington a month ago, and representatives were present from all the industrial centers of the country. A permanent organization was formed and officers elected. The principal work of the association will be to aid in the development of export trade and to cultivate sentiment in favor of reciprocity treaties.

At one of the railroad club meetings Mr. John Mackenzie, superintendent of motive power of the N. Y. C. & St. L., made some remarks which explains how it comes that railroad companies are showing themselves so favorable to the proposed change of rules which will make owners of cars responsible for all repairs. He said: "The principal point which interests us is the responsibility of car owners. Mr. Barr shows that private car owners pay less than 40 per cent. of the expense of taking care of their cars. The question then naturally arises: Who pays the remaining 60 per. cent.? The answer is, the railroad companies. This being the case, why should we not adopt a rule to make the car owners responsible for the defects of their cars?"

The Erie people report having obtained remarkably good service from driving boxes made of Magnus metal, which were placed under a ten-wheel engine. After making 111,800 miles, the engine had to be taken in for a general overhauling, and the driving boxes were found in such good order that they were refitted and put back. The master mechanic expects that the boxes will make 100,000 miles more. The metal is made by the Brady Metal Co., New York.



Hamar's Air-Brake Puzzle.

Editors:

For the benefit of the air-brake "doctors" who read the columns of your journal, would be pleased to have the following published:

In stating the facts as actually occurred, and for convenience, we will designate the cars as Nos. 1 and 2. A passenger train consisting of baggage car and two coaches arrived at a relay point; the two coaches were placed in siding, engine and baggage car detached from coaches and moved some distance away; coaches remained standing; after lapse of few minutes brakes suddenly applied and released on car No. 1 in same manner as making ordinary service stop, while at same time car No. 2 was not affected. In examining train pipe, cross over pipe and branch pipe leading to conductor's valve, no leaks were found; hose couplings also perfectly tight. What caused the brakes to apply and release in car No. 1 and not affect car No. 2, train pipe being perfectly intact as far as leaks were concerned?

Atlanta, Ga. W. T. Hamar,
Road Foreman Engines, So. Ry.

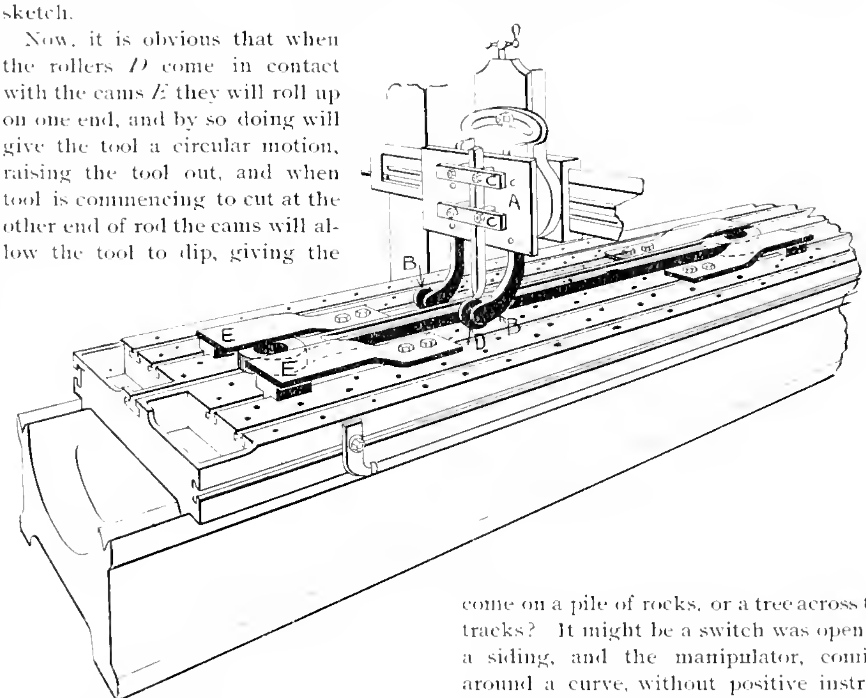
Kink for Planing Out Fluted Rods.

Editors:

Having taken pleasure as well as profit from reading the Shop Kinks in your valuable paper, furnished you from time to time by our brother craftsmen throughout the entire continent, I thought some foreman might not have a milling machine and at the same time have a set of side rods he would like to flute. We have been putting on fluted side rods, and not having a milling machine I set to work to design the planer attachment, as shown by the inclosed sketch. The material in the rods was very tough and hard pulling for the planer, but with this kink we made a good job and did it as quickly as it could have been done on a milling machine.

A is a wrought iron plate of suitable thickness, width and length. Holes are drilled in it so the plate will slip over the studs on tool attachment, removing the tool clamps, of course. Holes must be drilled out of center of plate as much as the width of the flute, so the tool will move across the rod before the arm *B* strikes the rod. After the plate *A* has been shoved over studs, the planer tool is put in place and the clamp *C* put on to hold the tool in position. Now we have two arms, *B*, riveted to plate *A*, as shown in sketch, bent so the ends will be well in advance of the tool, and in the end of the arms is a 4-inch roller *D*. There are four cams, *E*, made exactly the same. We clamped these on the face plate of our wheel lathe and bored them so the radius where the rollers *E* rolled on would be the same. Now the cams are bolted down to the planer bed, and placed in position so they will raise and lower the tool at the proper time. In order to make the cams rigid we blocked under them, as shown in sketch.

Now, it is obvious that when the rollers *D* come in contact with the cams *E* they will roll up on one end, and by so doing will give the tool a circular motion, raising the tool out, and when tool is commencing to cut at the other end of rod the cams will allow the tool to dip, giving the tool the same circular motion at both ends. The plate *A* and arms *B* work on the hinge motion of tool head, just the same as the tool would without the attachment.



Ionia, Mich. W. T. Rupert,
Act'g M. M., D., L. & N. R.R.

Air-Brake Emergencies—Terminal Inspection—Ice and Grief.

Editors:

While very busy at present, I cannot resist the impulse to reply in part to the article contributed by our Texas friend, on page 87, in regard to returning brake-valve handle to lap after an emergency application. It is a fact that while a train is standing with gages on brake cylinder and auxiliary reservoir, the air can be choked in the train pipe by returning to lap immediately after sufficient shock or reduction is had in train line to start the quick-action, generally with uniform results. In such a test, however, it will be found that as a rule all cars are working brakes and have been put in good order, if not already so. In trying this matter some years ago I found that with a three-car train about, if I remember correctly, one and one-half pounds were gained by this practice; but take an engine in motion and with the ordinary equipment, how near would a man come to the line between quick-action or partial service application if he should suddenly come on a pile of rocks, or a tree across the tracks? It might be a switch was open on a siding, and the manipulator, coming around a curve, without positive instructions to get that brake-valve handle round and leave it there in case of emergencies, might get mixed and try to get back to lap, and if the notch between running position and lap did not stick out about as far as the handle itself, would be apt to get over into release position, especially if a pair of wheels were on the ties, or any such little incident that sometimes calls for prompt action.

The point is, that with cars cut out, some perhaps with plain triples and often partial obstructions in the train line; some pistons traveling twelve inches, some five; some brakes leaking below train-line pressure and releasing; some out of order—and the implicit confidence that this order of things begets; the amount necessary to bring about quick action would vary so much that the results would not pay for the risks incurred, particularly if a suit arose and it was found such a thing had been attempted. In the present conditi n

of the air brake, I believe this practice to be very dangerous. It may be that in the future an opening will be made in the brake valve, in such a way that merely throwing brake-valve handle to full emergency position will surely bring about quick action with the equipment then in use; but in such a case this action will, in all probability, throw out a catch, or lock the valve in such a way that it cannot be moved back past lap until the catch has been returned to its place. No doubt this would prove beneficial where the emergency was being needlessly used—water tank stops, for instance—but a man with one eye sizing up a dangerous situation, and the other hunting up a soft place to light at, has little time to say farewell in, and is not apt to watch the notches on the brake valve very closely; and it appears essential that in such appliances the principle should apply that a single move in one direction only should be required to operate them in a crisis. The instructions here are to "use the emergency brake only when necessary," and then go for it without hesitation, but attempt no funny work while in doubtful situations, as I have often been told to "take the safe side and run no risks."

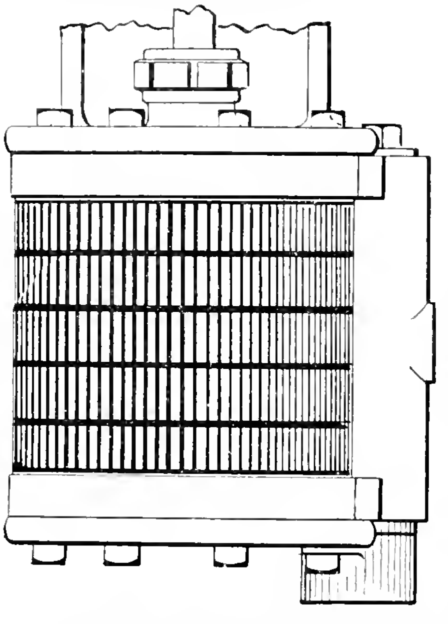
Brother Wood is on the right track, and I can assure him that I feel for him. For some reason there is seemingly a marked antipathy to a safe terminal test of brakes by those responsible for the movement of trains in yards and depots, and I have attributed it to the fact that the majority of those men earned their positions while yards were operated under different conditions, before the system of air brakes as now used, and the method of educating those who repair and operate it, had been inaugurated. (Moral—educate them, too.) As an instance of the general disinclination to care for the air brake, manifested in this respect, perhaps it has been noticed that during the recent heavy snows, while switching passenger cars, the hose coupling was often allowed to drag through the snow, and when filled was united to other couplings, the angle cocks opened, and the snow blown through the train line, undoing, in many instances, the work of cleaning done during the previous autumn. One very cold morning lately, I was out in the yard about daybreak (and, by the way, an inspector who is not aware of what is going on between 3 and 8 A. M. sees results afterward where he should have seen causes before). An engine was coupled to a train, and the plug in the angle cock worked so tight that it was turned with a coal pick (in line, of course, with Friend Wood's remarks), and tested—the air did not act as though it had a free passage. Getting a chance to examine this angle cock at noon, when it was warm, I found it worked easily. Unscrewing the bottom cap, the spring cavity was found filled with ice just melting; this when freezing had expanded and forced the key or plug up into the body of the angle cock. The preventative would have been to drain all places where water deposits and keep the hose hung up. The first was the fault of the inspectors, the second the fault of whoever uncoupled the hose—generally the yard crew who shift them and leave them in this condition, because they have no time to fool with them when the train is liable to be late getting off. On this account, I expect to find this summer many leaking angle cocks that otherwise would not have to be accounted for.

Roanoke, Va. GEORGE HOLMES.

Air-Cylinder Jacket and Guard.

Editors :

I take pleasure in sending you a blueprint of the air cylinder of a Westinghouse air pump, showing the air cylinder jacketed with perforated steel, and the lower



valve chamber cap protected from grease and dirt by a shield (as shown in shaded section at lower right-hand corner of cut).

By removing the wood lagging and Russia iron jacket, and putting on the perforated jacket, the air cylinder is kept much cooler and the capacity of the pump increased. The expense of keeping the pump in repair is correspondingly reduced.

The lower valve chamber shield keeps the oil and dirt that accumulates on the side of the pump and runs down into the lower air-chamber cap, from being drawn into the cylinder and air passages. This allows the valves to be kept clean and to wear equal with the upper valves.

The perforated jacket should be fitted closely between the flanges of the cylinder, and is held in position by the usual Russia iron bands.

The lower air-chamber cap shield is a thin brass casting, fitted neatly against the under side of the air-chamber collar, and is held in position by two of the pump head bolts.

These additions to the air pump have given such good satisfaction that I take pleasure in recommending their general use. F. W. WILLIAMS,

Mach. Shop F'man, M. & St. L. R.R.

Minneapolis, Minn.

Does Full Throttle and Close Cut-off Have Anything To Do With Worn Tires?

Editors :

In your December issue is published a letter from D. O. Smith, M. M. of the M. & O. R.R., relative to the wearing of tires caused by excessive compression, etc. As I have had some opportunities to note the causes of various kinds of worn tires, I long since came to the conclusion that certain flat tires and many other ailments of locomotive machinery were caused by the same "close cut-off and full throttle," as Mr. Smith terms it.

I presume the flat spots that Mr. Smith has reference to are those found on the tires immediately behind the right crank pin and on the quarter ahead of the left crank-pin, or on lower quarter with engine on forward center.

These flat spots are largest and appear earlier on the middle wheels of six-wheel coupled engines carrying high steam pressure, and the higher the rate of speed the sooner will the spots appear. I have seen them show up in six weeks after the tires had been turned, and I have also noted, as Mr. Smith states, that the engineer who ran his engine closest to the center was the one that had the flattest tires.

The conclusions of Mr. Smith as to the influence of the vertical lift of the counterbalance is, I think, correct. As you will readily see, the flat spots appear on the wheels at a point where the centers are just passed, and the steam pressure on pistons is greatest also where the vertical lift of the counterbalance would cause the adhesive power to be the least. I believe that at this point, when engines are running at a high rate of speed, the engine slips and wears the tires flat. As soon as they become worn they begin to pound. Then comes "loose eccentrics," "hot pins," broken spring-hangers and hard-riding engines.

As a general rule, I find accompanying these flat tires "leaky steam chests and cylinder heads front and back, also many broken cylinder heads," broken crank pins on main wheels that show breakage from front of pin back ; also, that pin had been cracked a little at a time.

During the past five years there has been considerable trouble on roads using the shallow fireboxes, on account of flues leaking, causing engines to steam poorly. In order to get steam, nozzles have been reduced in diameter sufficient to make steam irrespective of compression in cylinder. In this we have another contribution to causes for flat tires and hard-riding engines ; also, poor records for coal consumption.

Altoona, Wis. W. E. AMANN.

"Feeling" Brakes—Freezing—Independent Driver Brakes.

Editors:

February number of LOCOMOTIVE ENGINEERING contains reference to two or three subjects that I beg to touch on briefly. The article captioned "The Farce of Inspecting Brakes at Terminal Stations" is a chapter from life. Why would it not do to instruct incoming engineers at division terminals to stop their trains with a 10 or 12-pound reduction, and when the train is stopped, to draw off ten pounds more and *leave it off?*

If, after coupling on the relief engine the engineer succeeds in releasing the brakes left set, it is fair evidence that the angle cocks are open and that the triples are operative. This is my practice in freight service, when engine is cut off to do local work on road, or pick up cars to fill out.

Of course, where passenger trains are made up ample time should be used to test brakes fully. "Feeling" train brakes, either freight or passenger, after you pull out and before you swing into full speed is the best test after all. If you notice your train drags and slackens speed after making a 7 or 8-pound reduction, you can be certain that you "have them," and besides, you made the test yourself, alone and unaided. I do not think it denotes lack of confidence to feel your brakes after you get away from the depot where engines were changed; or that looking at your gage just before you shut off to stop is an indication of nervousness.

J. F. Barrett mentions a brake failure that is common in winter time north, viz.: The freezing of union that connects pipe from pump to main reservoir.

This is a dangerous ailment, for the reason that it creeps on you when you least expect it. Mr. Barrett gives no reason for this complaint. I have found it occur only where brass is used to make nipple and union nut. This metal seems to be a superior conductor to iron, and concentrating a degree of cold at this point collects the moisture that is carried over with the air, in the form of ice, gradually closing up the passage. For well-known reasons an enlarged opening at the point of discharge may cause a reduction of temperature, but a change in material will usually freeze the water where it belongs—at the bottom of the reservoir.

I am with Shaffner and his independent engine brake for freight service, "completely and unconditionally;" and while it is more than a luxury on mountain grades, it will pay for itself in a short time on ordinary roads, more especially in saggy divisions, or where the trains are held by both hand and air brakes together. The truss-rods on engines, draft rigging on cars, as well as links and pins that it does not tear apart are legion; and as to breaking in two—well! it is an enemy of Form 547 (Accident Report).

EUGENE MCAULIFFE.

Springfield, Mo.

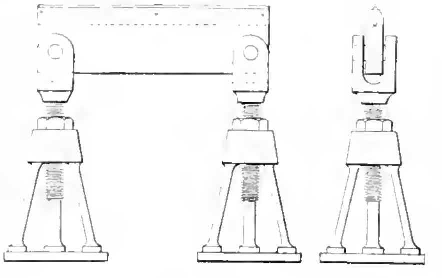
Trusses for Weighing Counterbalance.

Editors:

One subject that has received as much attention lately in mechanical papers as any other, is "Balancing Locomotive Drivers," and almost every paper has a diagram showing the effects of over or under-balanced engines on the rails.

There will be an article giving rules and diagrams, showing how to get the center of gravity, or telling how much of the reciprocating weight to balance, and lots of other information. But it has never been my good fortune to see described a pair of trusses that would do to weigh a pair of wheels on and be sure that they were right when you had them done.

Those shown here may not be the best, but they are so far ahead of the ones we used to have, and the plans I have seen used in what are supposed to be good shops, that I think they are about perfect.



The trouble with wooden trusses with straight edges nailed on, is that there is no way to take up the spring that is sure to come when the wheels are put on, and to build up blocks takes up almost all the room that there is between a pair of wheels, and the weight will spring then, the same as the wooden trusses.

The base of the ones here shown is the same as the base of skeleton jacks, but shorter. The base plate is 1 x 3 in. outside diameter, the legs of $1\frac{1}{4}$-in. round iron, 11 in. between shoulders; the top is the regular jack nut, but instead of having a thread nut in it, it is bored out $1\frac{13}{16}$ in.

The jaw is 6 in. deep, sides 1 x 3 in.; the screw is $1\frac{3}{4}$ x 14 in., with one nut $1\frac{1}{4}$ in. thick. The bar that connects the two jaws is 26 in. long, 1 x 6 in., and hung well down in the jaws. Plane a groove in the upper edge $\frac{7}{8}$ in. wide and 1 in. deep, in this put a steel straight edge $\frac{3}{8}$ x $1\frac{1}{4}$ x 26 in., planed parallel, fasten in with three rivets, drilling holes in the straight edge $\frac{1}{8}$ in. larger than rivets. The holes through the plate should be $\frac{1}{8}$ in. larger than the rivets that fasten it to the jaws—then there will be no bind. It is well to put a thin nut on lower end of screw—then it cannot be lifted out. One of these trusses complete weighs 250 pounds and is not liable to be carried off and used for other purposes.

The way we use them is to jack the wheels up high enough to let them under the axle, having the wheels clear the rails about 3 in.—then lower the wheels down on the trusses; then with a wrench and level proceed to level them up. These plates are stiff enough so that there will not be any spring. One other advantage of these—they do not take up very much room, and eccentrics need not be moved out of place more than one inch.

W. A. ROBERTSON.

Cedar Rapids, Ia.

The Folly of Recharging Before Emergency Application.

Editors:

In the editorial affix to an air-brake letter published in the February number, I notice that "many men who have studied up, figure that they can stop better if they recharge and then go to emergency, which is dangerous practice in a close place," and which has reference to cases where sudden emergency arises while brakes are in operation on service application.

In making an emergency application, the rapid action of the brakes and resultant increase of power is caused by, first, a full stroke of the triple piston, and then an action of the emergency valve that allows train-pipe pressure to enter the brake cylinder and fill it, and equalize with it before the auxiliary reservoir air has had time to feed into the cylinder—really, a "straight-air" application in addition to the automatic principle, and acting before the auxiliary reservoir has discharged its pressure to the brake cylinder.

When the emergency valve opens, and train-pipe air is admitted to the brake cylinder, the higher the pressure is in the train pipe the greater will be the braking power in the cylinder—naturally—and knowing it to be so, has caused many engineers and other air-brake men to believe that after a service application has been made, and an emergency arises, by returning the brake valve to releasing position, admitting the high pressure of the main reservoir to the train pipe, and immediately throwing the valve to emergency, this high pressure of air in the train pipe will enter the brake cylinder and supply a quick and *greater* braking power than may be obtained by at once moving the brake valve to the emergency position when a quick stop is necessary. The same principle is involved in a case where we are running along on the road with brakes released and charged, and danger looming up ahead; we throw the brake valve to full release for an instant, and charge the train pipe with the excess pressure of the main reservoir, before making an emergency application.

A year or so ago this subject was discussed in the *Locomotive Engineers' Journal*, and, I believe, in this paper, too, by men who ought to have understood the matter. Some of them really asserted that by moving the valve handle to the extreme left, and then quickly to the extreme right, a greater brake power would develop, than to obey the Westinghouse instruction book and go directly to emergency; but

most writers expressed a belief that "while it might be possible to gain brake power that way, it was *uncertain* and," as the editors say, "a dangerous practice in a close place."

But there can be nothing uncertain about it, and I have often wondered why the editors of the publications containing letters that disseminated such a dangerous theory allowed the matter to be finally dropped, unexplained, and admitting an uncertainty.

It is bad braking, when it isn't absolutely dangerous, to make a premature release; as to any possible benefit that might accrue, there is none. Of course, it isn't *always* possible on a fast run to stop exactly square with the water spout or the coal chute without getting the brakes on a little too hard and having to make a momentary release, and, after making such release, every engineer knows that before the brakes will again apply, a much greater volume of air must be discharged at the brake valve than the amount discharged at the previous application. That is because in releasing his brakes he filled the train pipe with a *greater* pressure than that in the auxiliary reservoirs—necessary, in order to release the brakes—and to again apply the brakes, he must reduce the train-pipe pressure to *less* than that in the auxiliary reservoirs, in order to cause the triple valves to be moved to the position for applying the brakes in making an ordinary stop; but to make an emergency stop, a still greater amount of air must be drawn from the train pipe before the pressure in the auxiliaries will be able to overcome the resistance of the graduating springs.

This graduating spring isn't very stiff; it don't require that a large *volume* of air shall be drawn from the train pipe in order that the auxiliary air may force the triple piston to compress it. *If the pressures in auxiliary reservoir and train pipe are equalized*, a rather light, but short, quick discharge will have the effect of an emergency application, as every engineer knows who has dipped into the emergency a little bit when he was in a hurry and didn't intend to do it, or who has to handle quick action brakes with a three-way cock.

Now, *to get any action of the emergency valves, the pressure in the train pipe must be reduced to less than that in the auxiliary reservoirs*, and if the brake valve has been returned to release position after drawing off air at service stop, every ounce of air that has been restored to the train pipe must be discharged before the train-pipe pressure is at an equilibrium with the auxiliary air, and then you are just where you were before recharging your train pipe, with the exception that the triple valve released some of your brake cylinder pressure when you "recharged," and the brake power is thereby lessened, instead of increased. The releasing air is not permitted to stay in the train pipe long enough to recharge the partially discharged auxiliary reservoirs. If it was, it would divide the operation of the brake into two separate stops, or applications.

Suppose we have our engine coupled to but one car, and it has a quick-action brake. The engineer's valve is of the latest pattern and feeds 70 pounds to the train pipe and allows 100 pounds to the main reservoir. After pumping up this pressure, we *quickly* discharge a volume of air from the brake valve, at emergency stop, that would not amount to more than a 7-pound reduction with plain automatic triple valves; but the car brake will apply in emergency style and use train-pipe air to assist the auxiliary pressure in forcing out the brake piston. Now, if there had been 80 pounds of air in the train pipe at the moment of application, could not we have thrown a greater pressure from the train pipe to the brake cylinder? *Not unless the auxiliary pressure was also in excess of 70 pounds.* It is the pressure of air contained in the auxiliary reservoir that causes automatic application of the brakes from either service or emergency stop. This fact should be kept in mind.

But suppose, again, that our first application of the brake was a service discharge of 10 pounds, and then an emergency confronting us, we find that we must use our greatest brake power and stop immediately; let us "recharge" and go to emergency, and see what advantage there is. After making the service reduction of 10 pounds, there were 60 pounds left in the train pipe and about the same pressure in the auxiliary after equalization. We throw our brake valve to full release and admit the 100 pounds pressure of the main reservoir to the train pipe, with which it will equalize to, say, 95 pounds. But we don't leave the valve in that position long enough to recharge the auxiliary reservoir; the pressure in the auxiliary is still 60 pounds, while that in the train pipe is 95 pounds, and before the triple valve will move to apply the brake, at either service stop or emergency, we must discharge something over 35 pounds of air from the train pipe, thus *delaying* brake action, while during the time that the 35 pounds of air are being discharged, the triple valve is exhausting the contents of the brake cylinder. Thus, the brake power decreases, and when the emergency feature of the quick-action triple gets in its work there is no greater pressure in the train pipe than there was before recharging. Of course, some little air feeds through into the auxiliary reservoir, but not enough to amount to anything, or to call it a recharge.

After making an application of the brakes, don't release them unless you are sure that you will have time to *recharge them* before making another application. If, in creeping up, or, more especially, dropping down, to a water tank, it is apparent that the brakes were applied too heavily and that you are going to stop too soon, they will have to be released; the best air-brake operators on the road can't always make a down-hill stop on a "chalk line" with consecutive applications and no release. But, if a premature release must be made, don't leave the brake valve in the releasing position any longer than it takes to move the triples, and the instant you hear the sound of the brakes releasing, pull the handle back and lap the valve. This will save main reservoir pressure and prevent the train pipe from filling with a greater pressure than is contained in the auxiliaries, for, from the time of lapping the valve until making another application the train-pipe air will nearly, or quite, equalize with that in the auxiliaries, if the valve is lapped *quickly* after releasing.

The last paragraph refers to the use of any and all Westinghouse triple valves, plain automatic or quick-action, and it should be remembered that it is a bad thing in air braking to ever have the air in the train pipe at any considerably higher pressure than the pressure of the auxiliary reservoirs, because, *this excess of pressure must be gotten rid of and train-pipe air reduced to a lower pressure than that of the auxiliary reservoirs, before brake action begins, either at service stop or emergency.*

Terre Haute, Ind. WILL W. WOOD.

Putting in Driving Springs.

Editors:

Referring to "Orange Pound's" communication in your February number, giving description of his method of applying driving springs and replacing hangers on the road, and his request if there is a better way he would like to have it, I will assume to offer some suggestions on the subject to help him out. If he will change the conditions, he will find his appliance useless, except his method of raising the engine, and this he can do with less trouble by running the driving wheel up on a wedge. If he will raise his engine so that bottom of driving box rests on the pedestal brace, and the springs are properly designed, they can be applied, as well as hangers without disconnecting equalizers, or the use of a hook and lever to pull them down, as he describes, and much time and hard work saved. L. C. NOBLE.

Pittsburgh, Pa.

In our last issue we published and credited to the *American Machinist* an article on "Locomotives Built Last Year," which was prepared by the *Railroad Gazette* and first appeared in that paper. We have several times collected information similar to that which was in the article referred to, and know that it involves a great deal of hard work. Mr. W. H. Boardman, in directing our attention to the mistake, which, however, was not ours, intimates that the article cost them as much as two pages of half-tone cuts would cost, and we do not think that his estimate is unreasonable.

Broken Rails.

BY JOSEPH ANTHONY.

When an account of a railroad wreck, caused by a broken rail, appears in the newspapers, it is liable to be classed as an unavoidable accident. A country paper lately, in giving an account of one, closed as follows: "No blame attaches to any one. It is one of those unforeseen accidents that cannot be provided against, and which is liable to occur on any one of our railroads at any time during the winter season." This is all wrong; and in the interest of all concerned, the truth as to the matter should be known and be utilized. When a disaster from this source takes place the question should naturally arise, How do rails break? or more correctly, How do rails resist breaking?

Is it not this way? The function of a rail, as a path on which car wheels run, is that of a beam or girder resting on supports or piers, at such distances apart as is determined by the rail's height, the tensile strength of its foot, the bottom chord, and the compressive resistance of its head, the top chord. While the supported load is immediately over a pier or sleeper, the real functions of the top and bottom chords, as chords, are not brought into use, but rather both these parts, and the web connecting them, sustains only a compressive force, a force which, when applied at such points, all rails are abundantly able to bear. There has been no rail broken in any track except when it has been subjected to strains other than those tending to crush it.

This condition of things, however, is far from obtaining when the load rests on the girder between its supporting piers, the sleepers; here, as is well known, the strains exerted are two, one to compress the top chord of the rail—its head, and the other to stretch its bottom chord—its foot. If the web of the rail is of sufficient vertical stiffness to keep these two members duly apart, that is, to keep the form of the girder intact, and the strains brought to bear on its top and bottom chords are not of sufficient intensity to rupture either of them, no breakage takes place and all is well.

It may be asked, seeing that the elements as to compressive resistance, tensile strength, weight of load and distance apart of the supports, as applied to weighted girders elsewhere, are matters so well understood, why railroad rails, acting as girders as they do, are not thus duly proportioned, and with a like margin of strength, a like factor of safety. Why should such an important engineering work as a railroad track be an exception to all else? Why should those calculations which insure safety in other structures be left out of the track's mechanism?

Paradoxical as it may seem, I assert that they are not left out. In a broad way, all the data involved in the case, is figured out and applied with such resultant numbers and forms as are sufficient for all needs. That is to say, the rails are sufficiently strong and the supports are sufficiently numerous for all practical purposes for which they were designed.

The answer, then, as to why failures so often take place, is to be looked for elsewhere, and it is to be found in the fact that the relatedness of the girders, that intimate and perfect relatedness which should exist between them and the piers designed to support them, is not maintained and does not exist as a working fact.

While ordinary sleepers may be called piers and should perform the functions of such, they do not do so, and the failure has its origin here. As little leaks will surely sink the largest ship, so here, the deviations from the plumb line of mechanical integrity wrecks our trains.

To however even a surface the successive piers may first be brought, and how equally distributed over them the load may be, they do not remain in that condition. An inevitable inequality as to the density and the permanence of the ballast under the sleepers ever allows and provides for their unequal settling, and instead of having piers of calculated, proper and known distances apart and sustaining power, these important functions in them soon become vague and practically unknown. That which is known for a certainty is only that the rails are approximately in place and that the sleepers are beneath them; but that there is maintained that constant, intimate and due relation which is necessary for their successful united performance, there is not the least certainty, and everyone who is interested may know it.

A practical result of this state is: that among piers thus uneven, some of them become as no piers at all, and the girder which should and is supposed to have a bearing on each of them has to span a distance greater than that which is due to its load and to its sectional area. A girder proportioned to cover only a short space is used to cover a large one. Its factor of safety as a girder is absorbed, and what can it do other than fail. Everything else in mechanics breaks under like circumstances, and considering the interests that are involved it seems the blindest of folly to expect immunity here.

This want of due relation of rails and the piers under them, may be further illustrated in this way: A railroad bridge made to cross a wide stream is usually composed of several spans, whose adjoining ends rest on suitable piers built up from the river's bed. Well, suppose that in the making of truss bridges, instead of making them of separate lengths, from pier to pier as now, it was cheaper to make them long enough to cover several piers; that is to say, suppose the bridge resting on its suitable piers should be one continuous truss from abutment to abutment. Now, suppose one of the piers under this bridge should be washed away, or otherwise fail to perform its office. While the bridge would yet remain in its place, would any sane engineer still hold it to be safe and use it for the road's regular traffic? None but a negative answer can be given to this question. Our gross and often fatal mistake, as to due rail support, lies exactly at this point, for none can successfully deny but that with some sleepers sunken and some of them raised and all made rigidly immovable by frost, a like set of conditions is furnished under our rails as is furnished in our supposed pier-sunken bridge. In all such cases, and they are numberless in the season when rails do most break, the danger line is far passed, and the real wonder is that there are so few wrecks rather than that there are so many.

In warm climates these mentioned unevennesses do not become so marked, and hence accidents attending them are proportionately few; in winter, however, in cold climates, they become numerous and disastrous in their results.

There are other causes why rails do not rest on their due and supposed supports. Aside from the unequal support received from the sleepers, due to the settling of some or to the heaving by frost of others of them, the rails themselves acquire a tendency to rest only on their extreme ends, and in fact become girders with no intermediate supports. This feature is termed crowning of the rails, and is due to the elongation of the top chord by the pressure of the rolling wheels, as pie crust is rolled out by the pastry cook's rolling-pin. The bottom chord not being subjected to such elongation, and both chords being tied together by the web, a compromise is effected between them, the top chord not rising as high as it would and the bottom one rising higher than is normal to it. The resultant form of a rail in use is thus more or less an arched one, and we find again that it does not duly rest on its supposed piers.

By the complete and whole girder capacity of a rail, if one pier, say under the central portions of its length, settles a trifle, a part of the weight due to it is transferred to the adjacent piers. At the ends of the rails, however, the joints, this girder capacity of the whole rail completely ends. It is true that there are various devices for so-called splicing the rails, but there has been none yet brought out that joins them with the same strength, no more nor no less, at all portions of the wheel's path along them. However mitigating the several splices may be in relieving the sleepers immediately beneath the joint of their excessive loads, due to want of practical continuity of the rail, they are continually being depressed more than their neighbors are, and, in freezing so, become of anvil-like rigidity for the wheels to spend their otherwise innocent, but now destructive, force upon. Another cause is thus found why rails do not evenly and securely rest on all the supports that it is inferred they do.

Attempts are sometimes made to fill up

the spaces that occur between the sleepers and the rails by the method of shimming. There are reasons why this practice is inefficient and of only partial worth. The irregularities to be shimmed are varied, and the exact thickness of the needed shim cannot always be determined, and much less be had. There are no means of fastening the shims in place, and worse than all, between the last shim used and a sleeper on which the rail next rests, there may intervene in its length an unsupported space that is dangerously long, and which may tax it quite beyond its power of endurance. The places where shims are needed most may be, and generally are, covered with snow and ice; the force of trackmen employed in winter is generally less than in summer, and what with the duties of such as are retained, in clearing not only the main line from snow and ice, but the yards and switches also, they have scant time and less inclination to dig to the base of each needy rail within the limits of their section. If shimming is effective why do tracks on which it is practiced ever fail? The whole matter is a makeshift, a delusion and a snare. Of course, duly raising a sleeper itself at such times is wholly out of the question.

The practical summing again is, that from all the agencies involved the rails are found to not evenly and securely rest on the piers as it is supposed they do.

There are some mechanical methods of illustrating the practical workings of this inequality of rail support that can only be shown by occular demonstration. There are others by which some idea as to what the rail's feelings, so to speak, may be under the treatment to which it is subjected in its unequally supported state, and of the results that are likely to ensue from the same cause. This treatment may be summed up by the word blows; that is, to hammer, to pound, we say, the blows of a car wheel. There is not only the great momentum of these blows to be resisted but their suddenness in connection has to be remembered. Indeed it is this last that is the chief factor in the matter, for many times the load that so suddenly breaks a rail, if let down on it gradually, would be entirely harmless.

As to one phase of blows, let a person smartly strike the palm of his open hand on a bare board or table and note the sensations. The sudden arresting of the hand on the table is quite like the same arresting of the unsupported portions of a rail on the solid sleeper beneath it. While the rail may not feel the stinging sensations that the hand does, the concentrated and intense vibrations set up in it, granulating and making it brittle, is well typified by the hand's smarting pains. When this is sensed, lay the open palm flat on the table and bear heavily on it with the other. Under almost any weight thus exerted there will be felt no stinging sensations as before, and equally absent will be the injury to any rail from any simple pressure it may bear, if it, too, rests on all the supports that it is supposed it does.

This aspect of blows, too, may be well sensed by driving a nail. A nail may be easily made to penetrate a board by the simple momentum of the falling hammer; a small force applied to its descent and in guiding it, suffices to do that which many times the force would fail to do by simple pressing on the nail's head. If a rail is not sought to be broken, weight it, within due limits, but do not hammer it; for if what is hammered is not broken, the hammer itself is liable to be.

There are many authorities as to the injurious effects of sudden and shivering blows on metals while under such strains as are loaded car wheels and the rails on which they run, and why they are not heeded in cases like the one under consideration seems to be due to the false impression existing, not only on the part of road officials but on the part of the public also, an impression that the rails do evenly and securely rest on all the piers that are provided for them.

Candy and railroad rails seem far from being related, yet there is a marked phenomenon common to both. The examples by which I have thus far sought to show the effect of blows on rails, have referred to cases where the rails did not rest on some of the piers along the middle portions of their length, and were suddenly brought to bear on them by the wheel, and if the rail did not break by being made a girder of undue length, it was made liable to breakage by being used as a hammer on its rigid supports, and thus breaking itself by its own sudden and shivering reactions. The next illustration will be as to those which are caused by a want of bearing, immediately at the joints, and to do so the phenomenon observed in making candy is made use of. Those who have attended on such occasions may have observed that while the candy was in a proper stage as to working and to temperature it could be readily bent in any direction, while if a sudden strain or blow was given it, it would as readily fly into pieces. Under a slow strain it would be as pliable as wax, while under a sudden impulse it would be as brittle as glass. This difference in its demeanor did not lie in the candy, but lay rather in the character of the strains which were applied to it. Due strains such as are legitimate to railroad rails, were harmless to it, while blows, or such sudden forces as were equivalent to blows, were destructive to it and are alike destructive to rails as well.

The philosophy of this seems to be that the strains which to both, could they but have had time to distribute themselves over a sufficient area, would be harmless, break them by being given so suddenly as to concentrate themselves over smaller areas than the tensile strength of such areas will sustain. To avoid a break-down, the sectional area of the material under strain, whatever that material may be, must be in proportion to the strain it has to bear. The suddenness of the strains borne by the candy and by the rail under review, have been out of due proportion to the space into which they were concentrated, and hence the result.

Further, as to low joint support. If there be the least space between the foot of the rail and its support, the wheel on its arrival instantly closes it by depressing the end to the sleeper. Instantly, I know, means instantly; but the term is all unmeaning, in that it falls quite short of conveying to us a sense of what the actual conditions are. If a train speed of but thirty miles per hour consumes but the merest fraction of a second in passing over a foot in length of track, what shorter time must it take to carry the pulsations over thirty feet of a frosty rail by the wheel's instantaneous contact with its end? The fact is, the pulsations cannot be so carried. There is not time for such to be done. Before the inertia of the rail's mass, distant from the generating blow, can be overcome, the respective tensile and compressive resistances of the rail's chords are more than matched and the rail is broken, and perhaps into several pieces.

An effect again of a sudden blow applied at the end of a rail with sunken joint supports may be sensed by trying to vigorously use a horse whip while holding it at or near its smaller end. The attempt is a failure, because the inertia of the handle end cannot be overcome and that part practically remains unused. Thus, too, a rail may be affected; a cavity at the end between it and one or two of the immediate sleepers, with a next near one on which the rail does rest and which thus forms a fulcrum, furnishes the same conditions as to strains on it as does the whip when used as stated.

If we consider the whip to be of steely hard metal, or, better yet, of glass, the idea of how rails break under the conditions which hereto we find them, conditions of not resting evenly and securely on the supports as they are supposed to do, and consequently conditions under which shivering blows are generated and given out, it will be clear how rails break and as to the nature of the remedy.

Blame for these breakages lies somewhere, and, to speak truly and plainly, it lies solely in the insufficient attention to the minutiæ involved in maintenance of the original integrity of the rails as girders, and the sleepers under them as their supporting piers. When this better attention is given there will be no more broken rails.

Los Angeles, Cal.

Employés of the D., L. & W. road at Elmira, N. Y., have organized what they call an "Air Brake and Technical School," and propose to discuss questions that are always coming up in railroad practice. Such schools are valuable to the men and the railroads, and the latter should be willing to stand half the expense, at least.

Additional Information on Air-Brake Handling—Examiner's Catechism.

By Clinton B. Conger.*

PREFACE.

The Air-Brake and Signal Instructions approved by the Master Car Builders' Association is the most compact and perfect short form of instruction yet issued. Every employé who has any interest in the air brake should possess a copy and carefully study it.

The questions and answers in this little catechism are intended as additional information to enginemen, by taking up points not treated on before. It has been the aim to ask questions not found in the M. C. B. book.

The questions from 42 to 90, inclusive, are by an air-brake instructor of wide experience. They were intended for use in examination for promotion to engineer, and cover a pretty fair range of air brake practice. There is nothing mysterious about the operation of the air brake. Each part has its own duty to perform. Take each part by itself and study it up, then get an idea of its relation to other parts, and you will find out that it is easy. You cannot learn it all at once, or in once reading over an instruction book.

REMEMBER

That the compressed air stored in the main reservoir is used to charge up the train line and auxiliary reservoirs, and that it is used to release the brake. Do not have any water in any reservoir, as it takes up the room needed for air.

That the compressed air stored in auxiliary reservoir is used to set the brake. There is an independent supply for each brake. Keep a full supply in each auxiliary.

That the brake is set by any reduction of pressure in the train line, no matter how it is made, if it is sufficient to move the triple piston and valve.

That the train-line pressure must be raised above the auxiliary pressure, or the auxiliary pressure reduced by bleeding, before the brake will release.

That you cannot recharge an auxiliary reservoir until the exhaust port in triple is wide open, unless air leaks past triple piston, as the feed port does not open till after the exhaust port is open.

That a second application after release does not set the brake as tight as the first full application, unless the auxiliaries have had time to recharge to standard pressure. This takes from twenty-five to forty-five seconds.

That the excess pressure is always stored in main reservoir.

That the small reservoir attached to brake valve is put there to give a larger supply of air to draw against for the preliminary exhaust of brake valve.

That if your driver brake does not work quickly and hold well with service application, in 99 times out of 100 it is on account of a leak.

GET ALL THE LEAKS FIXED.

That the cause of a hot pump is generally a leak somewhere, or waste of air in operating the brake.

SAVE YOUR AIR AND RUN THE PUMP SLOWLY.

That in all these questions and answers it is understood—unless otherwise stated—that 70 pounds is the standard train-line and auxiliary pressure; 90 pounds, main reservoir pressure; and 8 inches, the standard piston travel for all passenger, freight and tender brake pistons. The brake piston travels an inch farther when train is running than with a standing test.

Answers apply to Westinghouse brake.

Q. 1. Do you understand what is meant by the equalizing discharge brake valve? Have we more than one pattern?

A. Yes, we have two kinds of them in service, called *D-5* and *D-8*, from the number of the plate on which it is illustrated in the Westinghouse catalogue.

Q. 2. Describe how it operates, and what difference there is between the two patterns?

A. When it is used to set the brake, the engineer lets a certain amount of air out at preliminary exhaust and reduces the pressure over the equalizing piston; this automatically opens a valve in train pipe, and pressure there is reduced to about the same amount whether the train is long or short; thus the brake is set on all cars alike, as the train-line reduction is equalized. The older pattern, *D-8*, has the excess-pressure valve in one side, where it can be taken out when air is let out of train pipe. This valve is held on its seat by a spring, which is stiff enough to maintain about 20 pounds difference between the pressures in train line and main reservoir. The pump governor is piped to train pipe and set at 70 pounds. Each of these valves uses a double hand gage and has a small reservoir about 8 inches long connected to it by a small pipe; this equalizing reservoir is used to allow the cavity over equalizing piston to hold more air, so a more gradual reduction of pressure can be made in this cavity.

The *D-5* has a reducing or feed valve attached in place of the excess pressure valve, which is set to regulate the train-line pressure at not over 70 pounds, and holds the excess pressure in the main reservoir; with this valve the governor is piped to main reservoir and set at 90 pounds. Either of these valves can also be opened to let the air direct from the train pipe to the atmosphere, which causes the brake to go on suddenly and with full force.

Q. 3. What is the red hand of the gage coupled to?

A. The main reservoir pipe in the brake valve, and it always shows the main reservoir pressure.

Q. 4. What is the black hand of the double gage coupled to?

A. It is coupled to the pipe leading from the brake valve to the brake valve reservoir, and it always shows the pressure above the equalizing piston and in brake valve reservoir.

Q. 5. Why is it coupled in this manner?

A. When the engineer wishes to set the brake, he reduces the pressure above the equalizing piston a certain amount and then closes the preliminary exhaust; this reduction over the equalizing piston allows the train-pipe pressure to raise the piston, which opens the train-pipe discharge, setting the brake. As the engineer must know exactly how much reduction of pressure he makes, the black hand must show the pressure *above* the piston, and nowhere else, while making a service application.

Q. 6. In what position of brake valve does it also show train-pipe pressure?

A. When brake valve is in either full release or running position.

Q. 7. Then the black hand does not show the exact train-pipe pressure when on lap, or past lap towards emergency?

A. No, and you can easily prove this by placing the valve on lap and opening the angle cock at rear of tender; the train-pipe pressure will drop to nothing at once, which the black hand will not do; if there are no leaks in the brake valve and connections to brake valve reservoir, it will not drop any. Usually the equalizing piston packing ring leaks a little; this does little harm.

Q. 8. Why is this?

A. Because when the valve is on lap, the equalizing port which connects the train pipe with cavity over piston and the black hand, is closed, so there is no communication between them. If the *D-8* is placed on emergency so the running position port in rotary is over this equalizing port, the black hand will at once show main reservoir pressure, and the hands should be together. This is not shown with the *D-5* valve, as these ports do not meet each other.

Q. 9. When the *D-8* valve is on running position, do the red and black hands show the same pressure?

A. Not always. The red hand should show the most.

Q. 10. Why is this?

A. Because the air from main reservoir cannot get into the train line without going by the excess-pressure valve, and if the spring in this valve is set at 20 pounds, there will be 20 pounds more in the main reservoir than in the train line, and the gage will show it.

Q. 11. What is the advantage of carrying this excess pressure.

A. When releasing brake, it supplies the train pipe with a higher pressure than brake was first set at; this makes the movement of all triples to release position much quicker and surer. With a long train, it is absolutely necessary for this purpose. It recharges the auxiliaries quicker, ready for the next application of the brake. It charges empty cars quicker that

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are taken on the train. When brakes "creep on," they can be released at once by placing the brake valve on full release for a second or two, just long enough to raise the triple to exhaust position and not long enough to charge the reservoirs to a higher pressure, then returning it to running position.

Q. 12. What difference between the *D-8* and *D-5* valves in regard to carrying this excess pressure?

A. With *D-8* valve placed in "running position," you get the excess pressure before the train line begins to raise any, no matter at what pressure you start, as the main reservoir pressure must raise enough first to get by the excess valve before going into train line. With *D-5*, both pressures raise together till train line stands at 70 pounds, then the feed valve shuts, and excess begins to pick up in main reservoir. So you have excess first, with *D-8* valve, and hold it while valve is in running position; with *D-5*, you get train-line pressure first up to 70 pounds, then excess afterward.

Q. 13. How should the brake-valve handle be placed when running or standing with brake released, unless auxiliaries are being charged?

A. Always in running position. A small blowhole is put in the rotary valve to warn engineer that valve has been left in full release. All *D-5* valves should have this warning port; if it gets stopped up, it is a sign that there is dirt on top of rotary valve, which should be taken out and cleaned at once.

Q. 14. Please define the different positions of brake valve you mention.

A. The handle of brake valve has a spring pin in it. This pin is clear over against left side full stop when in "full release," against right side full stop when in "full emergency," against left side of middle stop when on "running position," against right side of middle stop when on "lap," or all ports covered. Between "lap" and first emergency comes the "service application."

Q. 15. Do leaks in the brake valve interfere with its work?

A. Yes, if there is a leak under the rotary valve from the main reservoir to train line the brake will release when valve is placed on lap. A leak from train line under rotary valve, or through train line discharge valve to atmosphere, or a leak between equalizing reservoir and brake valve, will set the brake tighter than you want it. If it leaks through gasket from main reservoir to cavity over equalizing piston 47 in *D-5* valve, brake cannot be set in service application. Using the brake valve on emergency habitually will tend to cut the rotary and seat quicker, as it brings sand and scales of iron rust up from the train pipe on the seat, which the service application will not do. If the brake valve is fastened close to the boiler head so it gets very hot, the leather gaskets get burned and crack so they leak badly.

Q. 16. What is the effect if equalizing reservoir pipe is broken so a blind joint has to be made? What is the effect if this reservoir is filled with water?

A. The brake cannot be set with a gradual application; there is so little air above the equalizing piston, it escapes out of preliminary exhaust so quickly that brake works with full application, with a very short train, sometimes emergency. Filling small reservoir with water has the same effect.

Q. 17. What should you do in such a case?

A. If joints cannot be made so as to use equalizing reservoir again, the elbow in train-pipe exhaust should be plugged and valve used with direct application port. The elbow has a thread cut in it for this purpose.

Q. 18. With the equalizing discharge valve, why does the air blow out of the train-line exhaust when brake is released, if working brake *on engine and tender only?*

A. Because the train line is charged up through a large hole in rotary valve; the cavity over equalizing piston and brake valve reservoir is charged up from the main reservoir through the small supply port for preliminary and equalizing port. If the train line is *short*, it will charge up to a full pressure quicker than the space above piston; train-pipe pressure will then raise piston and discharge valve, allowing air to blow out of train-line exhaust elbow for a second or two.

Q. 19. Can this action of the valve be of advantage to you?

A. Yes, if you hear this escape of air from train-line exhaust when releasing brake on a train, it is a sign of a short train line and is a notice to the engineer that an angle cock at the head end of train is closed, or something has got into the train pipe and stopped it up. You should see at once if an angle cock is not shut by some mistake or malicious intent. Check chains swinging against the handle will close it.

Q. 20. Does the amount of air which blows out of train-line exhaust when setting the brake, give you any idea of the number of cars in your train working air?

A. Yes; with engine and tender only, the train-line exhaust does not blow much, if any longer than preliminary exhaust. With a long train it takes some seconds for the train-line pressure to be reduced and equalize its whole length. You can, after some practice, tell whether you have a long or short train working air by listening to the amount of air escaping from train-line exhaust. This test shows the length of train line "cut in" and filled with air, *not the number of brakes that set.*

Q. 21. Can a gradual application of the brake be made, that is with only part of its full force?

A. Yes, by reducing the train-line pressure only a few pounds, say 5 to 7 pounds at first application; this reduction is necessary to make brake piston move over leakage groove; a lighter reduction than 5 pounds will not always do this. Two to 3 pounds at each of the succeeding applications.

Q. 22. Why does this reduction of only a few pounds in the train-line pressure make a light application of the brake?

A. With a light reduction the triple piston moves down slowly, opening the air valve slowly; the air from the auxiliary reservoir passes into brake cylinder through a small port and graduating valve; as soon as the auxiliary pressure is a very little lower than train-line pressure, the triple piston raises and closes the graduating valve so no more air can go into brake cylinder, thus setting the brake light. To illustrate this, suppose we let out 7 pounds of air, reducing train-line pressure from 70 to 63 pounds—that leaves 70 pounds above the triple piston (auxiliary pressure) and 63 pounds below it—the piston moves down towards the lower pressure, opening the graduating valve; when enough air has gone into the brake cylinder to reduce the auxiliary pressure a little below 63 pounds, the piston rises towards the lower pressure and closes the valve; another reduction produces the same effect, each time setting the brake tighter.

Q. 23. How much do you reduce the train-pipe pressure to make a full service application of the brake?

A. About 20 pounds, or from 70 pounds down to 50.

Q. 24. Why does a reduction of 20 pounds set the brake "full on"?

A. If the brake is in good order, with a piston travel of 8 inches, a reservoir pressure of 70 pounds will fill the brake cylinder and equalize in both at 50 pounds. When it has equalized, no more air will pass from auxiliary to brake cylinder, pressure on brake piston will not rise above 50 pounds, and brake cannot be set tighter. Any reduction of train-line pressure that leaves it lower than auxiliary pressure will set the brake tight. If a reduction of 20 pounds opens the air valve and *holds* it open, any further reduction will not produce any effect on it, and is only a waste of air which must be supplied from main reservoir when you want to release brake. If any check valves in quick-action triples leak, a reduction of train-line pressure below brake-cylinder pressure will let the brake leak off through this check into train pipe.

Q. 25. If the brake is defective and leaks off through piston packing, or any leaks in piping or triple valve, is it any advantage to let all the air out of train pipe in such a case?

A. It seems to make a leaking brake hold a little longer, but it is so short a time that it does not help very much to stop the train. A gage put on this brake cylinder will show that it only holds for a few seconds, and during that time with a light pressure. The proper way is to stop the leaks. A leaking graduating valve will

let the brake off with a *light* application but not with a *full* one; in this case the air exhausts from port in triple valve.

Q. 26. What is necessary to have brakes set alike with same reduction of train-line pressure, and release at same time with same increase of train-line pressure?

A. 1st. The auxiliary pressures must all be the same, so triples will move down towards the same reduced train-line pressure. For example, if one auxiliary has 70 pounds, another 60, a reduction of train-line pressure below 70 will set the first brake, but it takes a reduction of below 60 to set the second one. 2d. All piston travels must be the same, for a short piston travel will equalize at a less reduction and with a higher piston pressure than a long piston travel. When train-line pressure is increased, brake with long piston travel will release first, as the auxiliary pressure is lower. Thus, brake with long piston travel sets tight last, with less piston pressure, and lets go first. 3d. That all triples and brake pistons are in good working order and no leaks anywhere.

Q. 27. What makes the driver brake so slow to take hold if coupled to a train, when it works all right if engine and tender are working without a train?

A. Generally it is because it leaks somewhere, so the air leaks out without setting the brake, when a light reduction is made for the train brake. See about the leaks, first thing. The piston packing leather gets dry and hard from being so close to the firebox, and it needs soaking up with water and oil frequently in the summer time. No water can be used in the winter time, oil only. To test for leaks, set the four-way cock in plain triple for straight air (if possible); this will give you time to go around and find the leaks. If the piston leather leaks, the air will blow out of hole in the spring case or lower head of push-down brake. If the brake releases through the triple exhaust on a light service application, it is a good sign of a leaky graduating valve, which should be fixed at once. Using the brake valve on direct application position for service stops will sometimes kick the driver brake off, after setting the train brake. This is another reason why the direct application should *never* be used unless you want the emergency action of every brake.

Q. 28. Why does the tender brake sometimes stick and refuse to let off till auxiliary is bled a little, when all the other brakes on the train release promptly?

A. Generally not enough excess pressure carried. A great many tenders have 12 x 33-inch auxiliary reservoirs for an 8-inch brake cylinder; if, in this case, the piston travel is short, the brake piston pressure is 6 or 7 pounds higher than other brakes equalize at, and train-line pressure must be raised correspondingly higher to release tender brake. Then the tender triple gets more sand and dirt in it than any other triple, which causes it to wear and get defective. A leaky triple piston packing ring will allow any brake to stick unless very high excess is used.

Q. 29. What is the emergency or direct application?

A. If the train-pipe pressure is suddenly reduced at the first application 10 pounds or more, with the quick-action triple, the emergency part of the triple valve is brought into action, opening a large port in the triple so the air goes from the train pipe direct into the brake cylinder, not only setting the brake about 10 pounds, but also reducing the train-pipe pressure suddenly at that point, instead of all the air going clear to brake valve to escape and reduce pressure. This sudden reduction sets the next triple in same manner, which sets the next one, and so on to the last car; its action from one car to another is so quick that even on a long train it seems to catch all at once. When a quick-action triple takes air from the train pipe and sets the next triple quick-action, it also takes air from its auxiliary through a small port, after the train pipe has equalized, so the full application is made at 60 pounds, about 10 pounds more than the piston pressure in full service application.

A sudden reduction of train-pipe pressure which will pull the triple piston down hard enough to compress the graduating spring and let piston make a full travel, will open the large air port in plain triple valve, so brake will set somewhat quicker.

Q. 30. When is it necessary to use the emergency application?

A. Only in case of accident, or sudden danger to train or persons.

Q. 31. Can you get the emergency action of quick-action triple while brakes are set with service application?

A. No, unless they are set with a very light service application. If a full service application has been made, a sudden reduction of train-pipe pressure will make it lower than the brake-cylinder pressure, so check valve No. 15 cannot rise to let air out of train pipe. The auxiliary and train-pipe pressure must be considerably higher than in brake cylinder, or the emergency part of the triple will not operate.

Q. 32. Is it practicable to attempt to get the emergency action of the brake by suddenly recharging the train line for *one or two seconds* and then opening the direct application port wide?

A. No. By this movement you would partially release some of the brakes and get a lighter service application the second time than you had at first. Don't try it. Unless you have time to recharge auxiliary to 70 pounds, hang on to what you have.

Q. 33. If the train line is charged up with a high pressure from main reservoir when brake is released, will the brake set again *at once* with a small reduction of train-line pressure?

A. It will not set again until the train-line pressure is reduced below the auxiliary pressure. For example, if the brake has been set tight, the auxiliary pressure will be about 50 pounds for the first application; if you turn 90 pounds into the train line you must let 40 pounds out again, to draw train-line pressure below 50, before the triple piston will move; all this time your train is getting nearer the stopping point. This is one of the reasons why you run by when trying to make a stop this way; it takes so long to draw your train-line pressure down where it was before. In case you expect to apply the brake *at once* after releasing it wholly, or partly, put the brake valve on full release for an instant, just long enough to charge up the train pipe, and then put it on lap. This movement will hold your train-pipe pressure so near the auxiliary pressure that the triple is ready to act instantly with light service application.

Q. 34. Is it possible to let off part of the brakes and leave part of them set?

A. Yes. By moving the brake-valve handle slowly over on to "running position" the train line will gradually recharge; as soon as the train-line pressure is a little higher than the lowest pressure in any auxiliary, that triple will move up into exhaust position, letting off that brake. Then auxiliary will commence to recharge through feed port and hold train-line pressure down till that auxiliary is charged up high enough, when another brake will let off, and so on, till all are let off. The brake that holds least lets off first; it generally has longest piston travel, consequently lowest auxiliary pressure, and the operation here described takes place when piston travels are unequal. If triples all work alike, and with a light service application when auxiliaries all equalize with the train-line pressure, the effect of a very gradual rise of train-line pressure through excess-pressure valve is to send a small wave of air back through the train pipe; this can be so handled as to affect the engine triples first, and cause them to release first, others afterward. In case of a defective triple with a leaky packing ring, it will not let off at all, but will keep brake set (at train-line pressure, sometimes), as air will get past leaky packing ring instead of forcing triple piston up into exhaust position.

Q. 35. Why should a brake on a passenger train be let off just before coming to a full stop?

A. Because the brake shoes pulling down on the forward end of the truck, and pushing up on the back part of the truck, tilt the truck, and if brake is not let off until after the train stops, when the truck rights itself it rolls the wheels back a little and throws the body of the coach back, annoying the passengers, even if it is not severe enough to throw them against the seats. This trouble is not felt so plainly by the engineer when he has a good driver and tender brake, as the brake on the coach is what jerks the coach. Then, less power is required to stop a train going very slow, as at the instant of stopping, than

when running at full speed; if power enough is left on to hold a train at full speed, it must stop very forcibly at a slow speed. The brakes should begin to release about half a rail length from where the train finally stops; a little farther if going very fast, a little less if a very slow stop is being made. Practice will teach you the distance.

Q. 36. Why do some of the brakes "creep on" when the train is running?

A. Because there is a leak in the train line, triple valves, auxiliary reservoirs, or the auxiliaries have not all equalized after releasing the brake.

Q. 37. How can these brakes be released the quickest and surest way?

A. By moving the brake-valve handle from "running position" to "full release" just long enough so the rush of air will charge up the train pipe, and put it back to running position before any of the auxiliaries are charged any higher. This forces the triple valves of the sticking brakes up into release position, so air from brake cylinder exhausts and does not give time to raise the pressure in any reservoir. Sometimes this must be done a second and third time to release all of them. If brake valve is held on full release long enough to charge a reservoir higher than before, that brake will be sure to set as soon as brake valve is returned to running position.

Q. 38. When the *D-8* valve has been left on release position till train line and main reservoir have equalized at 70 pounds, and is then placed on running position, are the brakes apt to creep on at once? Why is this?

A. When the *D-8* valve is placed on running position it shuts off the air from train line till the excess pressure is picked up in the main reservoir. If train line leaks the brake will set. In such a case, run your pump a little faster for a few minutes—not over five—so as to get the excess quicker. If train is under motion and you feel a brake dragging, put the brake valve in full release for a second only, then place it in running position; this may have to be done a second or third time until air begins to go through excess-pressure valve, when it will hold brakes off. A short rule for this is: Keep your excess all the time by not using the full release position except at the time of releasing the brake; then running position will hold them off.

Q. 39. If governor is set at 70 pounds with *D-8* valve, and train line is charged from main reservoir higher than that pressure, is the brake apt to creep on?

A. Yes; the pump is stopped, and will not start again till train-line pressure is lowered to 70 pounds. During this time brake is pretty sure to go on.

Q. 40. How can this be avoided?

A. By not allowing main reservoir to charge train line and auxiliaries at over 70 pounds. When standing at a water tank, or any stop, with brake set, the main reservoir pressure is apt to run very high. If all of this is turned into train line and allowed to equalize at over 70 pounds, with brake valve carried in full release regularly, there is no way to prevent the brake setting. In this case, set it a little and at once release it; this will reduce the train line and auxiliaries below 70 pounds, so pump will go to work and you can hold brake off.

Q. 41. If main reservoir has water in it, how will it affect the operation of the brake?

A. The water in main reservoir reduces the supply of air stored there in proportion to the amount of water contained. The brake will set the same, but on a long train will not release as readily, as there will not be enough air stored to recharge the train line quickly, and you must wait to have it pumped. The main reservoir should be entirely clear of water, if it is necessary to drain it each trip, so as to get a prompt release and recharging of train.

Q. 42. What are the duties of an engineer as to his air-brake equipment when leaving the roundhouse?

A. To start his pump slowly and increase its speed after 15 or 20 pounds of air have picked up; to be sure that pump is in good order and will pump a full supply of air promptly; know that governor shuts off the pump when the proper pressure is reached and allows it to start promptly; see that lubricator has oil enough in it for the trip; know that there is no water in the main reservoir, drain cup, triple valves or auxiliary reservoirs; to test all the joints in piping, also brake valve and triple valves for leaks, and have leaks made tight; see that tender and driver-brake pistons have the proper travel and do not leak off when set; test the air signal, if one is used.

Q. 43. Why must the pump be started slowly; oil used cautiously; triple valves, reservoirs and strainers be drained, and how often?

A. The pump must be started slowly to allow the condensed water to get out of steam end, and run slowly till the air pressure rises, or the piston will strike the heads of air cylinder. The triple valves, reservoirs and strainers, or drain cups, should be drained every day in cold weather, once a week in warm weather. Oil should be used sparingly in air end of pump. It should *never* be put in through the air inlets of 8-inch pump, as it soon collects dirt and chokes up the air passages, which helps to make the pump run hot.

Q. 44. How do you test for leaks in the engine equipment?

A. When full pressure is obtained—70 in train line, 90 in main reservoir—shut off pump, place valve on lap; if red hand drops and black hand is stationary, it is a sign of a leak somewhere in main reservoir line, which begins at valves in pump and ends at brake valve. It may be in joints of piping, in main reservoir drip plug, in the air-signal line, in valves of pump or brake valve. If main reservoir pressure falls rapidly when you are sure it is not going into train line under rotary, examine each of the places mentioned. With the use of the "cut-out cock" under brake valve a leak under rotary is soon detected. Set the brake full on, place the valve on lap, shut the cut-out cock; if rotary leaks into train line the black hand will soon show same pressure red one does. With a leak in train line and cut-out cock shut or valve on lap, the brake will set; when cut-out cock is opened and valve on release, brake will let go and main reservoir pressure fall. There are many other ways of testing for leaks—using a torch is one.

Q. 45. Do you understand the difference between "automatic" and "straight air"? Explain it.

A. The automatic brake is set by a reduction of pressure in train pipe operating the triple valve, which admits air from the auxiliary to the brake cylinder. With "straight air" the air goes from the main reservoir through engineer's brake valve and train pipe direct to brake cylinder.

The automatic brake has its supply of air to set the brake stored under each car. With "straight air" it is stored in main reservoir only; the train pipe is empty before the brake is applied. This pipe and hose, as well as the brake cylinders, must be filled with air at 50 pounds pressure to make a full application; on a long train this cannot be done; when brake is released all this air is wasted.

The "automatic" uses only 20 to 25 pounds out of entire train pipe, and only so much from auxiliary as fills the brake cylinder, so automatic uses less air at each application of the brakes.

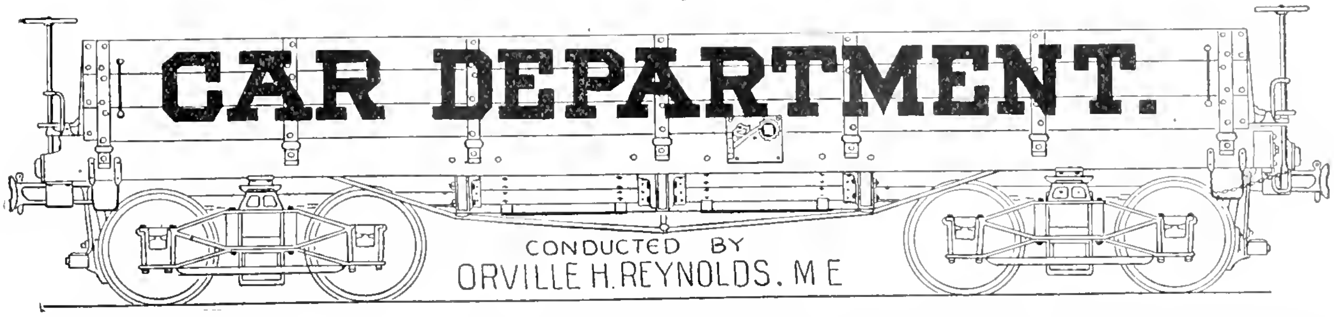
The automatic sets the brake with same piston pressure each time, and can thus be adjusted to get the full braking power on the car, and no more. With straight air, the piston pressure may be 90 pounds at one application, and with a longer train it may be only 30 for same pressure in main reservoir; leverage would have to be adjusted for the high pressure to avoid sliding wheels; with the low pressure you could not hold the train.

The automatic can be set from any car, straight air from the engine only. The automatic applies itself when hose bursts, or is pulled apart in case train breaks in two; in this case the rear portion of an all air-brake train usually stops first, diminishing the risk of parts running together. Straight air cannot be used in case of an accident that breaks train pipe or hose; that is just where the automatic does its best at once.

Straight air cannot be used with quick-action triples, as air is cut out from brake cylinder when cock in cross-over is shut.

(To be continued.)

The Verona Tool Co., Pittsburgh, Pa., have issued a popular edition, Blueprint Book of Track Tools, for free distribution.

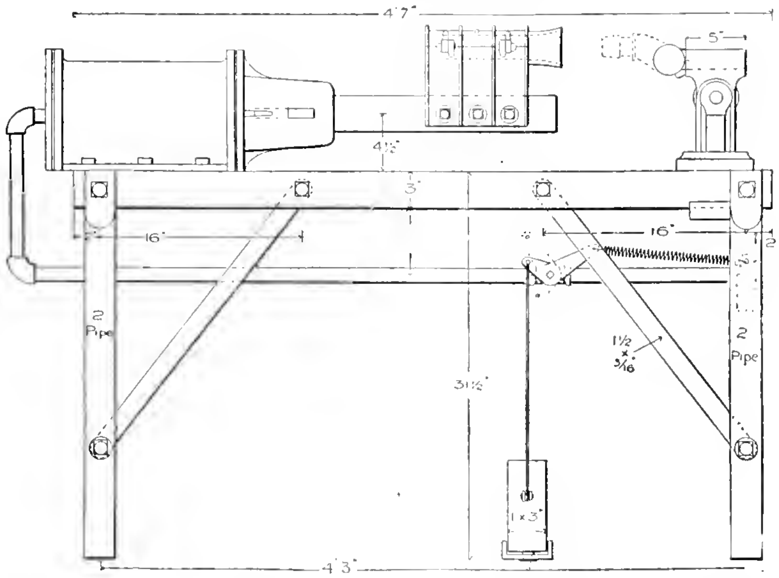


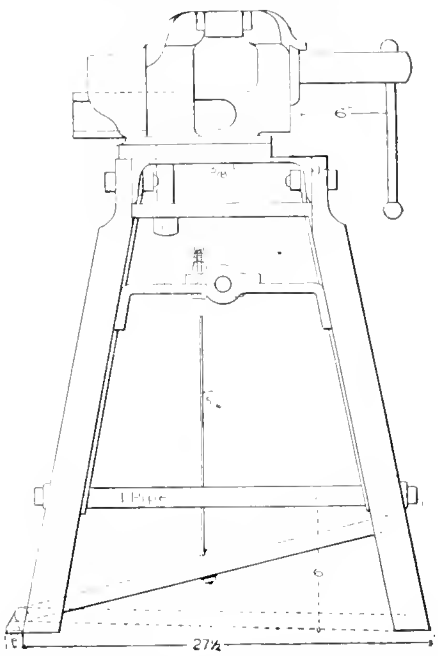
Machine for Applying Air Hose Fittings.

Many ingenious devices have been gotten up to cheapen and expedite the work in railway shops, in which compressed air is made to assume the major portion of the load. The uses of this machine persuader are legion now, and it would take a volume to recount all the good things that can be said about it in the direction of labor-saving.

There is one machine operated by air that is probably one of the pioneers in this field, and that is the machine for applying air hose fittings. It is doing business in many shops having any pretensions to modern methods of handling work, and it is found in endless styles of design, all looking, however, to the one end of getting out lots of work, and that cheaply. They will range in finish and adaptability, from the crude, first inspiration, embracing an 8-inch freight air cylinder and a wooden lever for a clamp, all secured to a bench and costing nothing to build, to the more pretentious affair that won't do any better work, but a little more of it, perhaps.

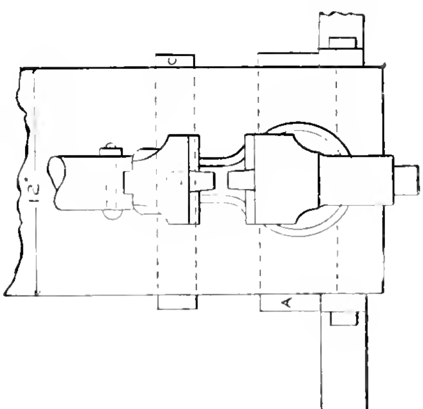
Indeed, there is almost as much work laid out on some of these machines as would build a fairly good lathe, home-made tools at that, for tool builders have not yet placed them on the market. The long-felt want is easily supplied at home, and it is doubtful if these machines would sell if built for the trade.

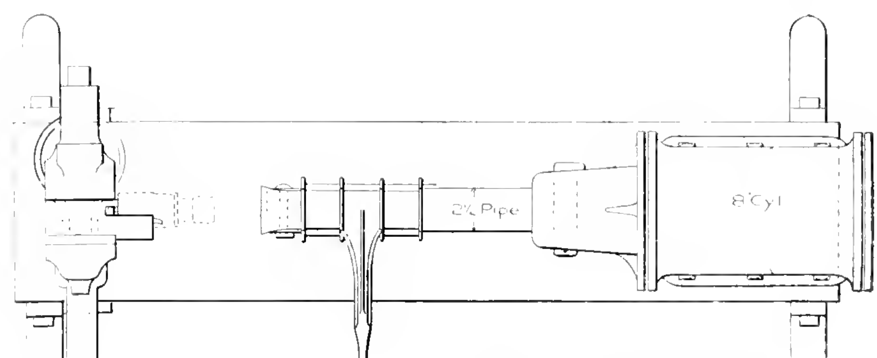




The illustration shows an old-timer that has covered itself with laurels. It is made from picked-up material that is found in any shop. A 12-inch channel iron, serving for a bed, supported by four legs made of 2-inch pipe, welded at the upper ends to 1 inch thick, and bolted to bed. An 8-inch cylinder is secured to one end of the bed, connected to air supply, and a common 5-inch vise is at the opposite end.

Secured to the piston rod is a clamp to hold the air hose that is to receive its fittings. In the vise is held a dummy coupling into which is placed the coupling to be applied to the hose.

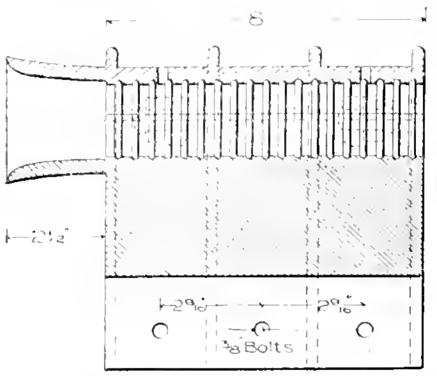




Air is admitted to the cylinder by a valve operated from a treadle on the floor, leaving both hands free to release the air hose from the clamp and the coupling from the dummy in the vise.

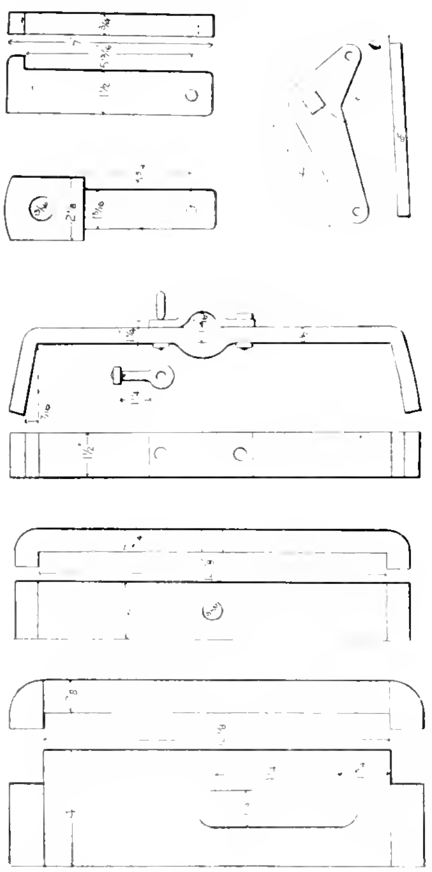
After all couplings are applied, the hose are handled the second time to apply the fittings at opposite end. A vise was used on this machine simply because it was at hand and could be used as a vise just as well on the machine as on a bench, and it was also of utility in securing the h e

clamps as the finishing touch in the operation. This machine has "assisted" in applying the fittings to 100 air hose in ten hours, a record seldom demanded in a repair shop.



It will be seen that the cost of this machine can be reduced to its lowest terms, by making the bed of 3 x 12-inch planking, and the legs also of wood.

A clamp, made of wood, to hold the

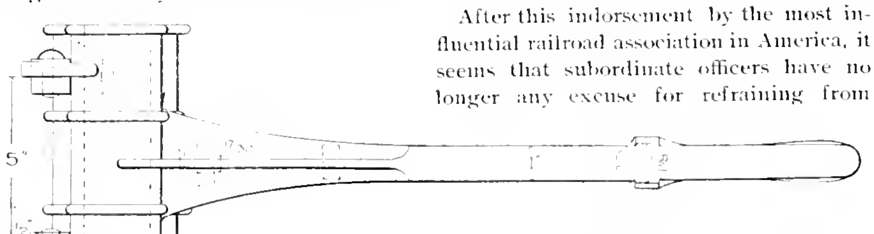
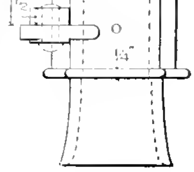


hose when forcing same on the fittings, while not as convenient as the one shown, would still be a serviceable affair for the purpose in many shops where repairs are not extensive.

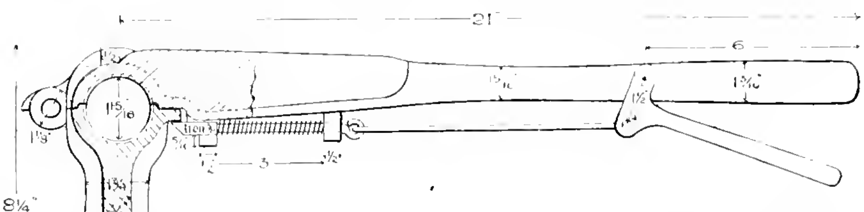
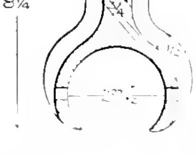
The Westinghouse Electric Co. have completed the removal of the Newark plant to the massive new works near Pittsburgh, and the Allegheny plant is being transferred also—as rapidly as the company's new shops can be gotten into shape for the machinery. The consolidated works, when completed, will be a marvel and well worth a visit.

To Aid the Adoption of Standards.

The Master Car Builders' Association has been laboring very hard for years for the adoption of standards, with a view to securing uniformity in railroad cars, but

much of the effort expended has been futile because the sentiments in favor of interchangeable parts did not seem to extend beyond the places where the conventions were held. Men would be found exhausting the resources of oratory on the floor of the convention, to portray the advantages that would result from the adoption of standards, and in not a few instances the same men would go home and do absolutely nothing for the next year to reduce to practice the principles they advocated. Some of the most ardent advocates of standards have been the most indifferent about adopting the forms which they arged upon others. There are rail-

roads which subscribe to the M. C. B. Association that appear to pay no attention whatever to the standards which they vote to adopt.

In some instances this was due to the management, which opposed any change which would interfere with old standards adopted by their roads. With a view of securing wider co-operation and support in the adoption of standards, the Executive Committee of the Master Car Builders' Association took up the question of standards with the American Railway Association, which is composed principally of railroad presidents and general managers. That highly influential association at its last meeting adopted the following resolution:

"*Resolved*, That the 'Details of Car Construction,' adopted by the Master Car Builders' Association, as published with the proceedings of its convention, held at Saratoga in June, 1894, be and are hereby adopted as standard by the American Railway Association, and all railway companies and car builders are recommended to conform thereto as soon as practicable."

After this indorsement by the most influential railroad association in America, it seems that subordinate officers have no longer any excuse for refraining from adopting the standards that the majority of railroads are already using.

On the New Haven System.

During a recent ramble in New England, which took us a great deal on trains belonging to the New York, New Haven & Hartford, we concluded that the passenger rolling stock belonging to that company is second to none in the country in providing for the comfort of travelers. Long practice has led us to travel with a keenly critical eye for the shortcomings of passenger cars, and the best testimony we can give to the New Haven people is that we found nothing to find fault with. The cars are roomy, have excellent seats, are well heated and lighted, and possess many other features that contribute to the comfort of passengers.

One of the most annoying small discomforts of ordinary cars, especially those on local or suburban service, is the open door. On most roads the passengers who go in or out leave the doors open. In cold weather this admits a rush of air that chills the car and keeps it uncomfortable for the rest of the trip. The doors are left open until some brakeman or passenger dashes it shut and stirs the nerves of every occupant with the explosive-like crack of striking the door against its fastenings. The New Haven people have automatic door closers on all their cars, and there is no violent slamming of doors. A great part of the equipment has vestibules to protect passengers going from one car to another, and those that have not got vestibules have platform gates, which prevent people from falling off.

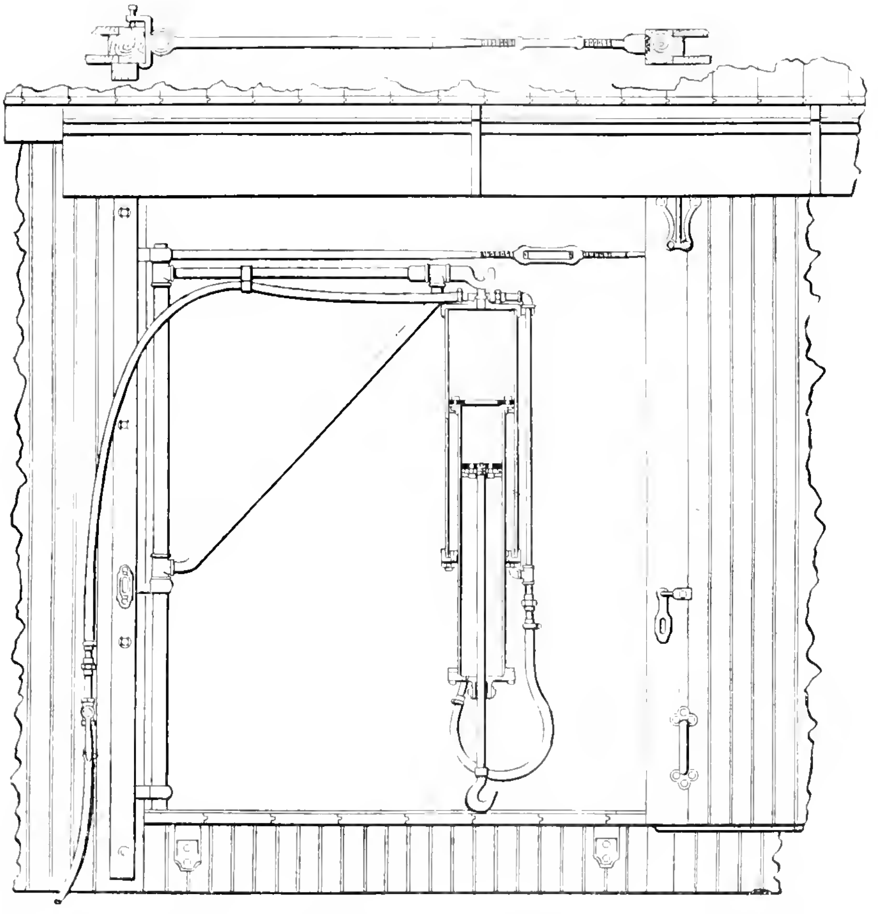
Where trains are crowded, a source of annoyance constantly coming up is the stowing away of small baggage. The ordinary rack is merely made large enough to hold an ordinary satchel until a curve is reached, when it tumbles down upon the heads of the passengers, disturbing toilets and tempers. On the New Haven road

they have continuous racks that hold all small baggage without danger of spilling—and a few babies, if necessary.

The Consolidated heating system in use on the road has been a great success during the present severe winter, which is the best that can be said for it. In the coldest weather the passengers have been comfortable. The Pintsch light enables people to read with comfort, which is all that could be desired. There is very little complaint to be heard among the passengers on this system, which is the best testimony to the comfort of the trains.

made out of wrought iron pipe, with proper cast heads, stuffing boxes, etc., the whole being connected in proper way as shown, with air supply, and a very convenient form of portable hoist for loading wheels or other material of not excessive weight, into cars or into warehouses, is obtained. The device is quite inexpensive, and has but to be seen to have its practical features appreciated.

"The device was designed and built by Mr. G. N. Dow, the division master car builder of the company at Cleveland, and is not patented."



Portable Hoist for Loading Wheels or Other Material Into Box Cars.

Mr. A. M. Waitt, general master car builder of the L. S. & M. S. Ry., sends us a blue print of the device shown herewith, and says:

"The drawing is self-explanatory, the device consisting of a convenient portable crane made of gas pipe and fittings, held in the doorway of a car or of a building by means of suitable clamps, the bottom of the mast of the crane resting on the piece of short iron ordinarily put in the doorway of a car as a threshold. The strut, consisting of gas pipe with solid end, having screw thread in it, is connected by a turnbuckle with another short piece with screw thread on one end and a serrated foot on the other. This short end with serrated foot can be extended so as to make the strut fit any doorway. Suspended from the arm of the gas-pipe crane is a telescopic cylinder

At the annual meeting of the Central Railroad Club, held at Buffalo last month, the following officers were elected for the ensuing year: president, Samuel Higgins, of the Lehigh; vice-president, E. B. Bronner, of the Michigan Central; secretary and treasurer, H. D. Vought, of the Buffalo *Courier;* executive committee—the president, chairman—C. E. Rood, O. P. Letchworth, P. H. Griffin, T. A. Bissell, George W. West and John McKenzie.

We have received an illustrated catalogue of the Ohio injector, which is made at the company's works, at Wadsworth, Ohio, the sales department being at Monadnock Block, Chicago, Ill. The injector is of the lifting variety with a starting lever, and has the connections arranged according to the No. 6 Pennsylvania standard.

Some Things to Consider in Changing the Rules of Interchange.

The "Responsibilty of Owners for Defects in Cars" is the topic of the hour with the roads of the country, and great efforts are being made to educate a favorable sentiment, which will tell when the question comes up to a vote in the coming convention.

It is obvious that a subject of such vast importance should receive careful and painstaking consideration. In the quick apprehension of the beneficial advantages of such a radical change, perhaps certain phases of the subject have not received the consideration the subject demands.

With a view to helping the general cause, we are pleased to present some views on the other side from Mr. R. P. C. Sanderson, division superintendent of motive power of the N. & W. Mr. Sanderson has constructed the annexed chart, where the various items relating to the subject are plotted.

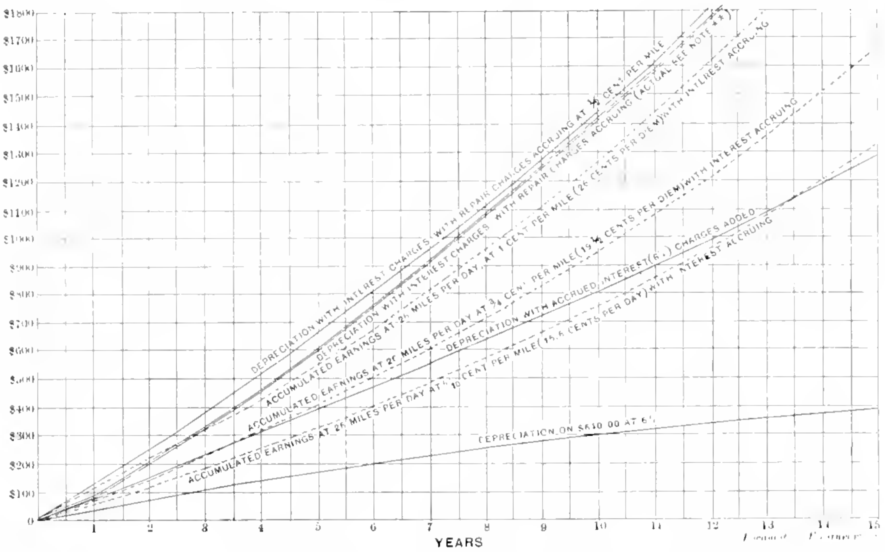
Concerning this, he makes the following explanation: Chart showing average earnings from mileage of twenty-six miles per diem, at six-tenths, three-fourths and one cent per mile, compared with the depreciation, interest charges and maintenance charges on a $640 box car. Interest on capital and accruing from earnings and expenses being rated at 6 per cent. per annum. Repairs are placed at one-half cent per mile; this includes maintenance, but not lubrication or renewals. Depreciation is figured at 6 per cent. per annum of the yearly depreciated values.

At the present mileage rate of six-tenths of a cent per mile, the accumulated earnings will equal the depreciation and interest after thirteen years and five months, allowing nothing for repairs; so it would be manifestly unjust to charge all maintenance and repairs to owners, under Rule 8. On a mileage rate of one cent per mile, all repairs and maintenance (exclusive of accidents and wreck damages) could be charged to owners, provided they were credited with the full twenty-six miles per day, without injustice, for the two curves run very nearly parallel, at a distance apart nearly equal to the second-hand and scrap value of the car, so that if the car, at the end of any given time, should be torn down, the earnings, plus the scrap value, will very nearly amount to as much as the total of the depreciation, interest and maintenance charges. If the average mileage per car could be increased on account of increased train speeds, which will follow the general introduction of air brakes, the result would be the same as an increase in the rate per mile. The basis of twenty-six miles per day is from October report (page 10) of the American Railway Association, where the Committee on Car Service gives the total mileage for the first six months of 1894, and the total days by which this mileage will have to be divided as equaling about twenty-six miles per day.

The figure of one-half cent per mile for

repairs and maintenance, exclusive of oiling, inspection and renewals, is based on the most accurate information I could get at, both from our own records and those of other companies who are known to be maintaining their cars.

The main lesson to be learned from this diagram is that the present mileage rate is entirely insufficient, it only covering the depreciation and interest at the end of thirteen and a half years, and that it will take a rate of one cent per mile (or at least a per diem rate of twenty-five cents) to pay for the depreciation, interest and maintenance, exclusive of renewals. If this were the case, then at the end of the car's life, it will be noticed by referring to the diagram, that the earnings, plus the scrap and second-hand material, when the car is torn down, will just balance the total expenditures, plus taxation, leaving the capital intact for reinvestment, this capital having earned 6 per cent. interest during this period.



The double line curve = is plotted from *actual repair* figures, being an average of 842 W. & A. box cars, as given in E. C. Spaulding's report of car mileage and repairs on the W. & A R. R. covering a period of sixteen years.

If we leave the door open for dishonest, or rather unscrupulous railroad companies to charge all their labor for inspection and maintenance of cars (which amounts to 24 per cent. of the whole) to the owners of foreign cars, by allowing them to charge any amount they choose to other roads, it will simply mean the broader line at the top of the diagram or chart will be raised and that the earnings should be correspondingly increased to offset this—otherwise the companies owning the cars will be the losers. It will further mean that it will be a direct inducement to railroad companies not to own cars at all, but to get their car service by the use of foreign cars, and in this way they will not have to invest capital in cars at all and will be able to charge their entire car repair expense to the owners of cars they are detaining and using.

In computing the earnings of a car on the six-mill per mile basis, the mistake has been frequently made of taking the average mileage of cars made on their *own* roads. This is wrong. We must figure entirely on the mileage reported from *foreign roads*, which is about twenty-six miles per day as the whole problem of car service and interchange only refers to service and maintenance while away.

I give you below detailed statement of total average cost of repairs of one W. & A. box car at the end of fourteen years' service:

Axles	$45 41
Bolts	28 77
Brasses	129 88
Cast iron	38 77
Carriage bolts	1 25
Chains	2 59
Labor	174 76
Lumber	67 52
Lag screws	2 16
Nails	5 42
Paint	11 20
Screws	39
Solder	2 53
Springs	27 58
Tin	98
Wrought iron	70 21
Wheels	94 08
Total	$704 20

In conclusion, it is right to say that if we could depend upon absolutely honest administration, the total expense of car repairs at the end of a year to a railroad company, under the new plan, would not be decreased or increased from the present figure, provided they were keeping their own cars in proper repair. If, however, for financial or any particular reasons, they allow their equipment to run down and go without proper repairs, their expense would be increased and they could not control their expenditure for car repairs except by refusing to honor bills, for the reason that other railroad companies would be at liberty to make repairs which they themselves should properly have made.

As far as a saving in inspectors is concerned, I feel confident that the alleged claim of large saving in wages of inspectors to be made will be found to be fallacious. I know on many roads to-day there are no more men employed than must be employed for safety. It is true, a little more of their time could be spent on repairs instead of inspection and carding, but if the movement of the cars under such change is expedited there will be no time for the men to make any repairs on these cars at purely inspection points. Mr. Barr's plan for practically making railroad companies maintain their own cars is preferable to Mr. Marden's plan of making each railroad company maintain all cars, both their own and foreign, while on their lines, in that railroad companies can feel that they can do necessary work on other people's cars without loss to themselves; whereas, if the equipment is allowed to run down, generally in hard times, other people's cars will be slighted by railroad companies in their endeavors to keep down expenses, and the general condition of equipment will suffer in consequence. It is my very decided opinion that if Mr. Barr's plan is put into effect, we will need a permanent arbitration committee very shortly afterward, or, rather, the arbitration committee will have to hold daily sessions, as the disputes which will arise under this new plan will probably be far greater than those which now arise, because at present we have something definite in the shape of a card to act upon, whereas, hereafter, the arbitration committee will have to settle all cases of question and fact, and judge of evidence, as to the correctness of statements, etc., which they have heretofore declined to do; but something of this kind will be absolutely necessary under Mr. Barr's plan.

If the motive power officers who are now urging this new plan of interchange would think the matter over, and inquire into the real cause of the trouble they are trying to alleviate, I am certain they would find the principal cause of the trouble has been due to the fact that the inspectors were originally not allowed to card properly, but had to refer the question of carding to some higher officer. Especially has this been the case with the smaller roads, and, also, this has been very largely brought about by the joint inspection plan, where there is a chief joint inspector whose object is to make his position secure by making a large amount of work for himself. The officers on many small roads also have been known to give instructions to inspectors that a card must not be issued until the matter has been referred to them to insure that the card has been properly given. This is, of course, absolutely wrong, and if they have employed men that they could not allow to issue cards without having the matter referred to headquarters to see whether the card is proper or not, the remedy is simple. They should have employed competent men and given them full and thorough instructions. It has also

been too frequently the case that the book of rules has been placed in the hands of ignorant inspectors, without any explanation at all or without any pains being taken at all by the motive power officer to go over it with them, calling attention to every change, and to ascertain clearly whether the paragraphs are fully and uniformly understood by all inspectors. The frequent additions which have been made to the rules in latter years, partly with a view to protecting some companies against temporary imposition and partly with the idea of giving inspectors full instructions, have defeated the object they had in view, in that they are too often not applicable to cars of various designs and lead to disputes instead of facilitating interchange. Instead of going by wholesale into Mr. Barr's or Mr. Marden's plans, it would be far wiser for railroad companies to recede gradually, to recognize that they have made a mistake in making the rules too cumbersome, to depend more on the judgment of inspectors, to introduce individual joint inspection at interchange points by harmonious joint agreements between railroad companies, selecting men agreeable to both, giving them jointly full and clear instructions concerning the rules, and furnishing them with a pocketful of cards to issue without restriction. By cutting out a large number of clauses in our present rules which lead to the disputes and delays so frequent at present, by abolishing the duplicate card clause, so the recording of cards which may come to us on cars may be entirely unnecessary, thus taking away a large part of the work and delay which occur at present, and by setting a six-months limit to the cards (which clause should never have been repealed), we could, I believe, facilitate interchange as much as will be the case with Mr. Barr's plan, and avoid the risk of a large number of disputes and difficulties which are bound to arise with any radical change such as Mr. Barr proposes.

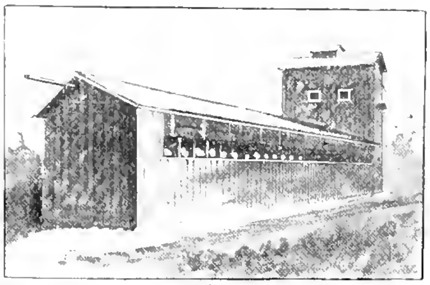
On the Great Northern they use a device, worked from the cab, for pounding the netting in extension fronts to dislodge cinders stuck in the openings. Across the arch above the netting runs a shaft, on which are fixed two iron rods that act as strikers on the netting; the end of the shaft on the left side of the engine extends outside the arch far enough to attach an arm, from which a rod extends back to the cab, where the fireman may "jar things."

The Pennsylvania Co. sold the seats that were used in their special World's Fair cars to their employés for fifty cents each. Except that they are a little scratched, the seats are about as good as new, and were dirt cheap, when we consider that the parties who made the seats wanted $2.00 for a new end, or arm casting.

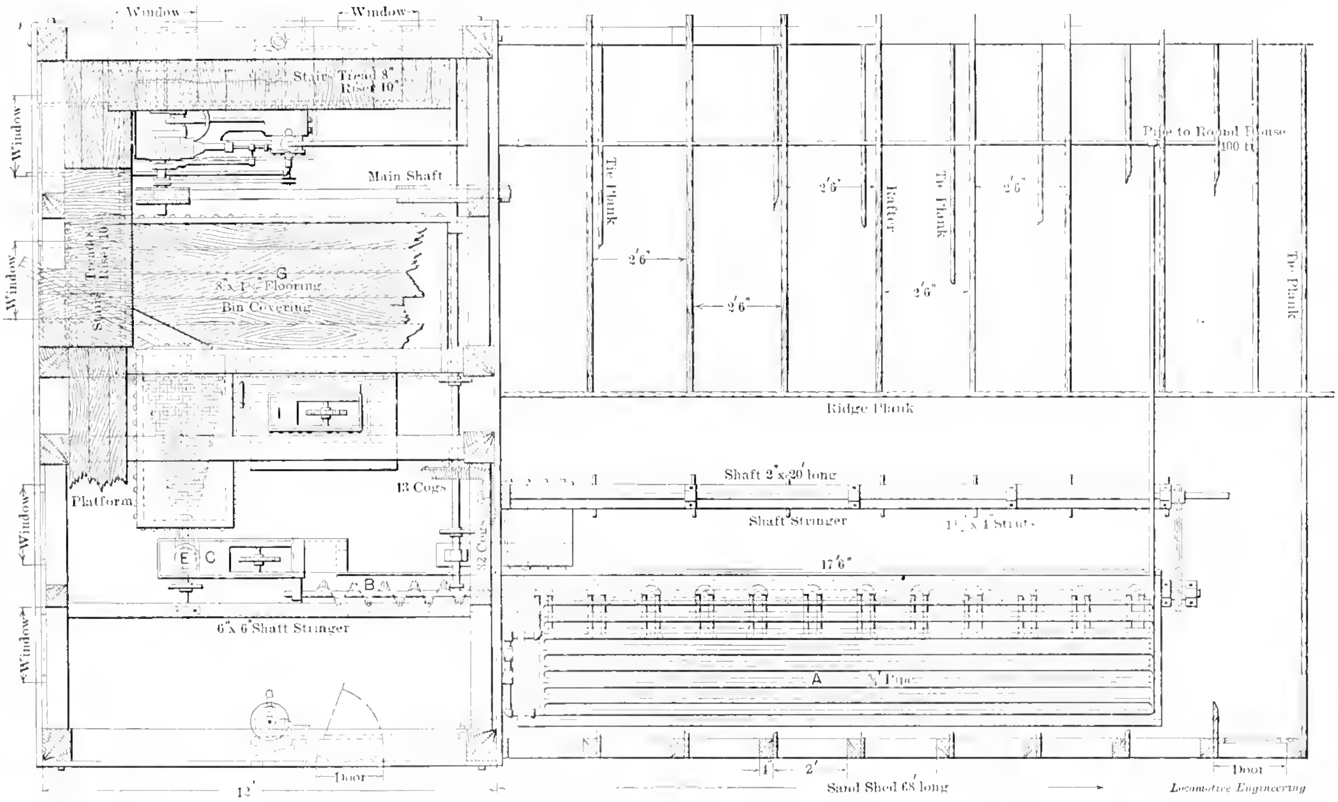
The latest railroad to go into the hands of a receiver is the Norfolk & Western. This really has been a very well managed property, the policy of building up and extending the fine mineral traffic having been persistently followed. The prevailing depression in business and the extension malady proved too embarrassing, and the system is now to be managed by a receiver.

A Model Sand House.

The problem of supplying, handling and drying sand for a large railroad is no small item, yet one in which little ingenuity has



been employed to improve on old methods. The old cast-iron cone stove, with a casing around it, is the usual means of drying, shovels and man power the mode



A Model Sand House—Plan.

of handling, and buckets the means of putting on locomotives.

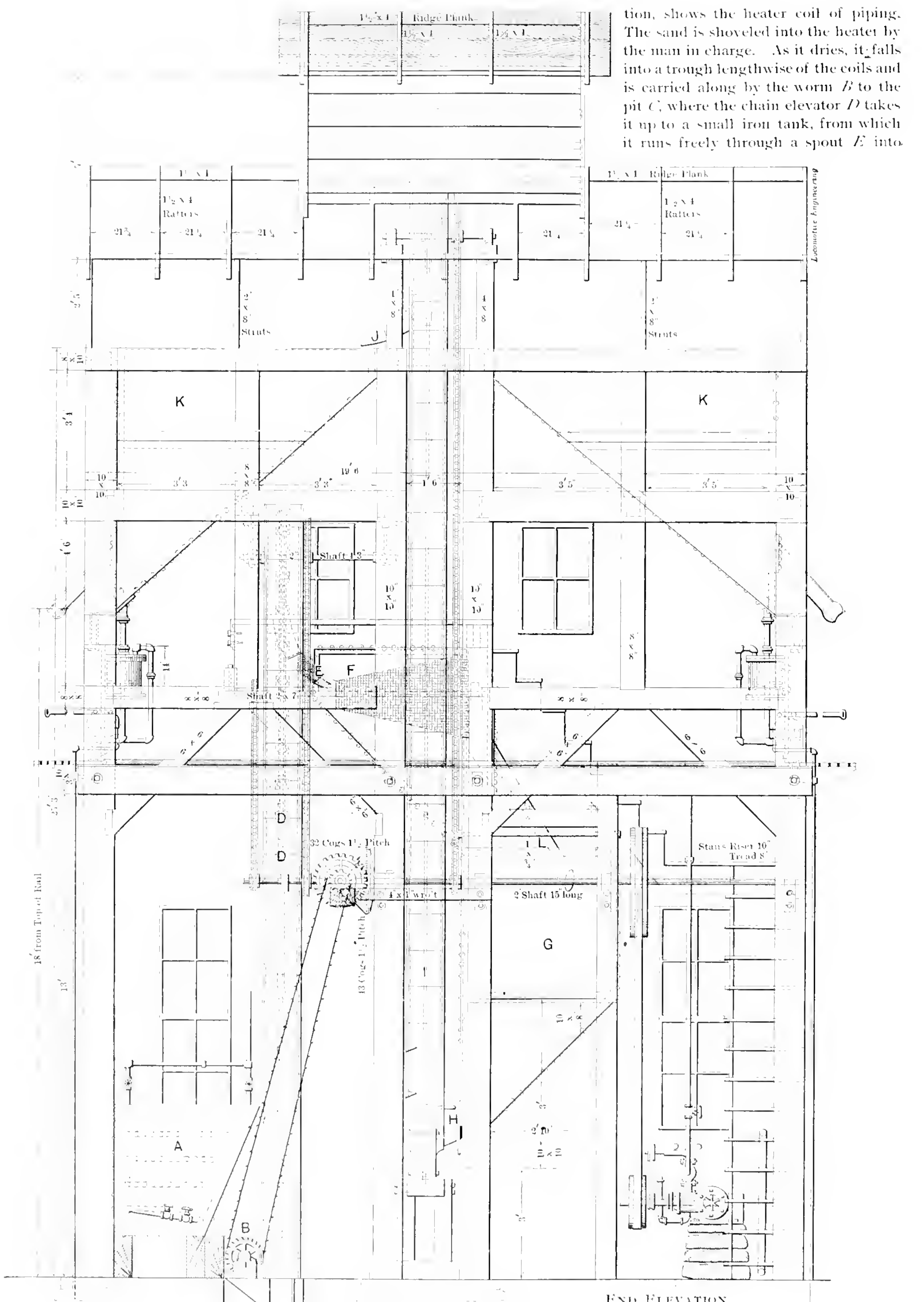
Master Mechanic C. T. McElvaney, of the M., K. & T. road, at Denison, Tex., has in use a sand house in which one man does all the work for a large number of engines, not very expensive to construct, and requiring in the three years it has been in service less than $25 for repairs.

A little study of the engravings will make the construction of the house and the plan of its machinery plain.

The perspective view shows the house as seen from the outside: one side is on the main track, and engines can be sanded up there; the other side faces the roundhouse track, and engines can be supplied there; sand can also be shoveled from cars into the bins from either track.

The letter *A*, both in the plan and eleva-

tion, shows the heater coil of piping. The sand is shoveled into the heater by the man in charge. As it dries, it falls into a trough lengthwise of the coils and is carried along by the worm *B* to the pit *C*, where the chain elevator *D* takes it up to a small iron tank, from which it runs freely through a spout *E* into



END ELEVATION.

the revolving screen F. Here the sand drops into tank G, while the stones and dirt go through the cone sieve and outdoors by the spout L.

The dry sand runs from tank G by gravity into the pit H, and is there carried by the elevator I and discharged through spout J to the bins K K, from which spouts are carried outside on either side of the house. These have movable spouts, much like the spout of an ordinary water tank, to carry the sand to the engine boxes.

When the spout is in the engine sand box, the man that handles it moves a lever that operates the valves of an air cylinder that handles the slide of spout, and is positive in operation. It cannot be left running, as to let go the handle is to cause the sand to be shut off automatically.

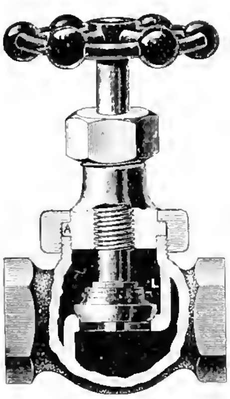
In this house, a small engine handles the machinery, and is run by steam brought 400 feet from the shop boilers.

One man dries 500 cubic yards per month, working ten hours a day, and there is always dry sand on tap. They formerly had four large sand stoves going night and day to keep up the supply.

From our engravings, we think it would be a very easy matter for any master mechanic to construct a similar sand house. It is certainly an improvement that is needed at every large terminal.

Lunkenheimer's Regrinding Valves.

We present herewith a view of Lunkenheimer's regrinding globe valve, which possesses some features of special merit. Instead of the hub being threaded direct to the body of the valve, it is merely fitted into it plain and rests upon a flange which fits upon the upper edge of the opening, as shown in annexed cut. The hub is then secured by a nut which fits over the flange, and is threaded to the outside of the body of the valve. The result of this arrangement is that the valve can be re-ground at any time with the greatest facility, because all that is necessary is to loosen the nut, remove the hub, place a little sand and soap under the disk, and then replace the hub, leaving the nut loose so that the hub is free to turn with the stem during the re-grinding.

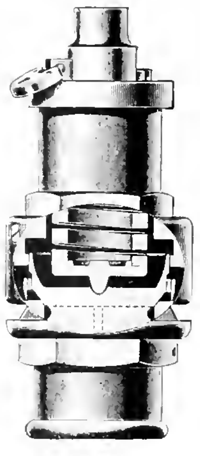


A piece of wire or nail is passed through a hole provided for that purpose in the lower end of the stem of the disk, so that the disk will turn with the stem during the re-grinding, which, of course, it does not necessarily do when the stem is in use.

The hub being in place when the grinding is done, effectually centers the stem and holds it in proper place, so that the regrinding is done correctly. The valve can thus be readily ground while in position, and in many cases this does away with the necessity for breaking connections. The disk is also easily replaced when required. These valves (on account of having an outside thread and union connection for holding the hub to the valve shell) are always easily taken apart, as the hub will not "cement" into the shell, as is the case with other kinds.

These valves are made of gun metal throughout, tested and inspected before leaving the works, and, as a proof of their superiority, are extensively used in rolling mills, refineries, on locomotives, steamships, and in the United States Navy on cruisers, where the requirements are very severe. They are made by the Lunkenheimer Company, Cincinnati, O.

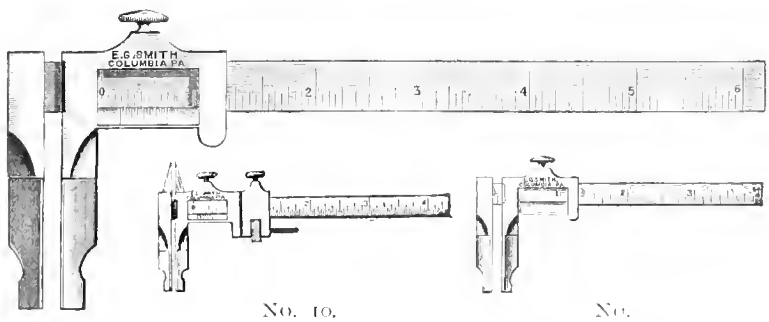
Ashton Open Pop Valve.



This engraving shows partly in section, partly in perspective, the Ashton locomotive open pop safety valve, as made with patented pop chamber, encased spring, pivoted spring disks, lock-up attachment and under discharge outlet. The valve is noted for its durability, accessibility, and for the quick relief it gives from excess of pressure.

Some Modern Measuring Instruments.

The accompanying illustrations represent a line of calipers, or caliper squares, as they are usually called, which, although being on the market for the last two years, are no doubt new and interesting to most of our readers.



No. 5.

No. 10.

No.

The No. 1 cut represents a caliper which is graduated in 16ths and 32ds, for machinists and woodworkers, working within these limits.

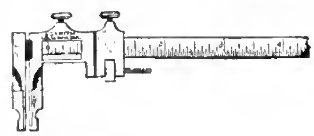
The No. 3 style is graduated in 64ths and 100ths, for inside and outside measurement, without mental calculation. With this style caliper no mistake can be made by adding ¼ or ½ inch, whatever the thickness of the jaws may be, which is done or has to be done on all other calipers of this kind.

No. 5 is graduated in 16ths with Vernier, to read 128ths or 64ths. The 128ths can be read as easily as 16ths on an ordinary rule, which makes the caliper of exceptional value to those whose eyesight is not the best. No mental calculation is required for inside measurement on this style caliper.

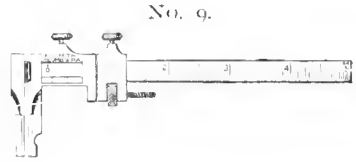
Both the No. 9 and No. 10 are graduated in 50ths with Vernier, to read 1000ths of an inch on one side, and on the other in 16ths with Vernier, to read 32ds, 64ths and 128ths, for inside and outside measurement. For laying out work, etc., the No. 10 has no equal. The points can be ground without losing their accuracy.

Any of the above style calipers are furnished in the metric system, either graduated in millimeters alone, or millimeters with Vernier, to read 10ths or 100ths, when desired. There are quite a number of these instruments in use in some of our leading concerns and educational institutions, where they are giving excellent satisfaction.

These are first-class tools and warranted accurate. All the parts are made of steel, and the jaws and end of scale are hardened. The set screw acts in conjunction with a spring slide, so as to prevent injuring the main slide, besides giving the sliding head a neat and even motion, so very fine measurements can be obtained quite readily without the ordinary clamp and screw adjustment.



No. 9.

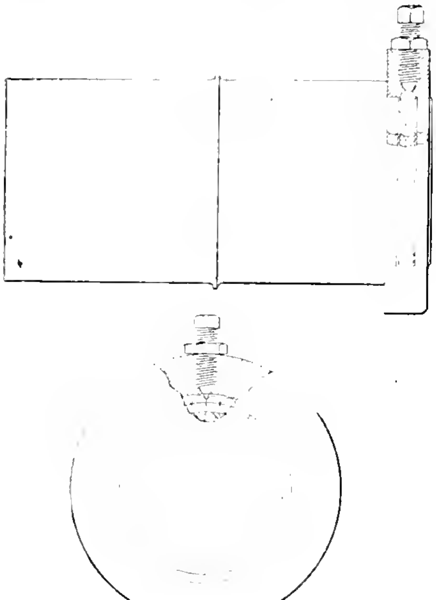


No. 3.

The utility of these calipers is not as well known to mechanics and those working to standards and sizes as it might or should be, which is mostly owing to the high prices which are usually charged for accurate measuring instruments. Anyone wanting a full description of this class of calipers should address the maker, Mr. E. G. Smith, of Columbia, Pa.

A New Pin-Collar Fastening.

The Norfolk & Western people have original ideas, and do things different from their neighbors, not always better perhaps, but at least original. Their fastening for collars on pins carrying solid-ended rods is



something new, and has been in use some months, without any trouble.

They simply turn a groove in the center of the collar seat on the pin, and a corresponding groove in the bore of the collar, and fill the hollow thus made with steel balls. A pointed set screw is then forced into the ring of balls, jambing them so that they hold the collar from turning.

To take the collar off, they remove the set screw and turn the collar upside down, when the balls run out.

This plan holds evenly all around the pin. Steel balls are extremely cheap now, so that it would probably be as cheap as any fastening used.

Shoenberger Steel Co.

The well-known Juniata Iron and Steel Works, of Pittsburgh, Pa., have in the past been operated by two firms. Shoenberger, Speer & Co. attended to the blast furnace department, and Shoenberger & Co. operated the rolling mill. The two firms have now been merged into one under the name of the Shoenberger Steel Co. A number of important improvements have been effected in the works lately, which facilitate the methods of steel production.

The firm of Shoenberger & Co. is the oldest concern in Pittsburgh engaged in the manufacture of iron and steel, having been established in that city in 1824. For a number of years the firm was known as Shoenberger, Blair & Co. The plant of this firm contains the following equipment: Seventeen gas producers, 13 single puddling furnaces, 13 heating furnaces, 1 soaking pit, 4 annealing furnaces, one 5-ton hammer, 12 trains of rolls (1 muck train, one 8, two 9 and one 16-inch bar; one 36 x 24-inch, one 60 x 24-inch and one 72 x 24-inch sheet train; one 31 x 112-inch plate train, 1 nail plate train, 1 blooming mill train and 1 continuous train), and 12 horseshoe machines; two 12-gross-ton open-hearth steel furnaces; two 6-gross-ton Bessemer converters, with modern appliances, first blow made March 15, 1886. The product consists of steel plates, sheet steel, firebox steel, iron and steel horse and mule shoes, steel blooms and billets, horseshoe bar and toe calks, the annual capacity being 100,000 gross tons.

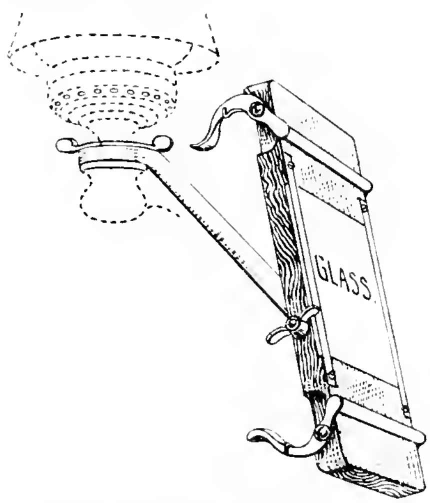
The Juniata blast furnaces of Shoenberger, Speer & Co. consist of two stacks 75 x 14 and 75 x 16 feet in size, equipped with six Massicks & Crookes' hot blast stoves, the annual capacity being 102,000 gross tons of iron. The entire product of these furnaces is used by Shoenberger & Co. in the manufacture of Bessemer steel, and the firm are also large buyers of pig iron in the open market.

Harman's Order Holder.

The little device shown herewith is intended to avert disasters through forgotten orders—oh, how many a funeral can be charged to that!

Orders that are placed where the engineer can see them, and where the fireman can see them, are not so liable to be forgotten as those read hurriedly and shoved into the overall pocket.

Mr. Harman, who has served his time on the footboard, makes a neat device that is fastened to the gage lamp stand, and can be swung to any angle around it; the board can



be tilted and fastened at any angle and both fastenings secured with set screws.

The orders are held by two spring rods covered with fluted rubber tubes, that hold the thin paper across both ends, the ground glass permitting orders to be read easily at night.

This device is sold very cheap, and it would seem as if men who risk their lives, day in and day out, on the *reading* and *remembering* of orders, would appreciate and buy these things.

Anyone interested should address Stephen L. Harman, Box 345, St. Augustine, Florida.

Lubricators.

BY GEORGE ROYAL.*

In 1827, Maryland granted the first charter to the Railway Company in America, authorizing them to carry on a business of transportation; that road is now known as the Baltimore & Ohio. In its beginning no one ever dreamed of its being a steam road, but Peter Cooper built the first locomotive engine, the first built in America, which was the first to pull passengers this side of the Atlantic. Its weight was one ton, and its cylinders were three and one-half ($3\frac{1}{2}$) inches in diameter. Its boiler stood upright on the frames, and engine was connected by gearing with the wheels. If we can see in our mind's eye this engine placed on the track, and then compare it with the improved locomotive of to-day, we can realize the vast advance that has been made. Wonderful things have been accomplished, regarding which it is interesting to learn just how they came about. Time will permit me to mention but a few points out of the wonderful improvements made, and I will content myself by bringing to your notice one of the more modern inventions, namely, the sight-feed lubricator.

The hydrostatic lubricator with continuous feed, operated by a water column derived from steam condensation, has been known and used in stationary engine practice as far back as 1870. The up-drop sight-feed feature, in the same form as it is so extensively used at present, and in which the oil rises in drops through a water column, was invented in 1873, by John Gates, then chief engineer of the Oregon Navigation Company, and subsequently mayor of the city of Portland, Ore. These early lubricators, however, could not be used on locomotive engines, since their proper operation depended upon the equality of pressure at points of steam inlet and oil outlet. There was nothing in the construction of these lubricators to equalize the pressures, and the result was that when placed on a locomotive engine they could not be made to work on down grades, when a partial vacuum existed in the oil pipes. Not only would they not operate properly with differential pressures, but the oil would be sucked, or siphoned, out of the vessel, rendering the lubricator inoperative even after steam had been turned on. In early days of railroading, common hand oilers were used, screwed directly into steam chest or cylinder, and the enginemen had to fill them occasionally in the same manner as the oil cups of the different bearings, rods, eccentrics and other moving parts. Such oilers were provided with valves and cocks to prevent the steam in cylinders from blowing through them. The place of these most primitive devices was subsequently taken by the tallow cups, which had the advantage that they could be

* Synopsis of a paper read at the Traveling Engineers' Convention.

operated from the cab and assisted by the partial vacuum in oil pipes in running down grades, and by a jet of steam, which was supposed to spray or vaporize the oil, carrying it to the points to be lubricated.

The next oiling apparatus introduced was the patent steam chest lubricator, originally manufactured by Nathan & Dreyfus. This cup was in the line of decided progress, since its action was automatic, dependent upon steam condensation, but it had the disadvantage of its predecessors in providing for an intermittent feed only and not for a continuous one. The great desideratum in locomotive lubrication was that the oiling should be done continuously whether the engine was steaming or not, that it should be done in sufficiently small quantities to be economical and yet answering all demands of the machinery, and that it should be visible, so that the enginemen would have the lubricating under perfect control and be enabled to lubricate the cylinders and steam chest, not only sufficiently but at the same time economically, and see the process going on.

In 1876, Nicholas Seibert, an engineer then in California, for the first time suggested the necessity of equalizing the differential pressures in a locomotive lubricator, and took out a patent for an equalizing pipe arrangement. While Seibert knew what he wanted to make a successful locomotive lubricator, yet he seems not to have possessed the mechanical ability to carry his idea to a successful practical issue, and his lubricator, with the exception of a few experimental ones, could not be used or become known. Proceeding upon the foundation furnished by him, other inventors, Holland, Mitchell and Baker, tried to build a successful locomotive lubricator, but with little more success than Seibert himself, until the latter part of 1882, when it was discovered, as it appeared after a long interference litigation in the Patent Office, by George H. Craig, that the proper manner of equalizing the differential pressures in a lubricator consisted in chocking, or huddling up the steam coming from the equalizing pipe in the steam chamber at the discharge of the lubricator, and not to allow this steam to flow freely into the discharge pipe, as Seibert, and others after him, had attempted. With the discovery of the proper methods of equalization, the success of the sight-feed lubricator for locomotive engines was assured, and its rapid phenomenal progress is now a matter of common knowledge among railroad men.

The first sight-feed locomotive lubricators placed upon the market by the Nathan Manufacturing Company were the so-called twin cups, by which each side of the engine was furnished with a separate and independent sight-feed oil cup. These were originally of the down-feed pattern, in which visible oil drops fell through a glass steam chamber, and subsequently were made of the up-drop pattern, in which the oil drop ascended through a column of water furnished by condensation. The next was the oiling of the two cylinders out of one common vessel, which combined the operating parts of the two sides of the locomotive engine, yet kept entirely separate and independent one from the other, so that one side of this double sight-feed lubricator might be shut off without in the least interfering with the proper lubrication of steam chest and cylinder of the other side. The air-brake pump was originally fed by an independent sight-feed lubricator; lastly, the air-brake oiling apparatus itself was embodied within the lubricating apparatus for the cylinders; and the result to-day is the triple sight-feed locomotive lubricator, in which the two cylinders and the air-brake pump are fed out of one common vessel, while the action of all three feeds is separate and independent, and each of them provided with its own sight-feed glass, and yet one gage glass answers for the three independent feeds.

I would call your attention to what I said about equalizing the differential pressures in a locomotive lubricator. In order to get good service this must be fully understood. I would here state to you that it has been very difficult to have all concerned in operating locomotive lubricators understand the principle of equalizing differential pressures. Not only is this the case with enginemen, but also those in charge of the same. A very large amount of the difficulty has been, and is to-day, due to a violation of the equalizing principle. I would, therefore, urge upon you to get a thorough knowledge of the equalizing of different pressures, and it will enable you to lay your hands upon the cause of trouble ninety-nine times out of a hundred, for it is possible for a master of machinery, a locomotive builder, or one of our best mechanics, to put on a sight-feed lubricator in such a way that it will never do good service; and furthermore, it is possible for it to be put on in the very best manner and yet not do good work, on account of its not being understood and not being rightly handled by the operator. If I can impress upon your minds this fact, my efforts at this time will be well repaid.

Hydrostatic lubricators with continuous feed, operated by a column of water, have been known since 1870, but only since 1882 has the equalizing differential pressures been fully understood. Although Seibert, in 1876, caught a glimpse of what was needed, yet it was for George H. Craig to give us the way how to equalize the differential pressures and how the lubricator could be made to work successfully on a locomotive. If a perfect sight-feed lubricator is placed in a convenient position to enginemen, is connected to dry steam by no less than three-eighths (3/8) inch pipe and valve, inside diameter, then there is but one reason why this lubricator will not do the best of service, and that is, because the operator does not open his steam valve wide. When he wants the lubricator to work he must be sure to open steam valve before any other; when he is done with it, shut off all other valves before closing the steam valve. By attending to this, you will find that nearly, if not all, your troubles will disappear. With this care there will be no siphoning oil, no muddying up of water in sight-feed glasses and no irregular feed, for the equalization of pressure will protect the lubricator against all these things. But an engineman may complain even though the boiler steam does enter the lubricator as it should, and will tell you that his lubricator does not feed regularly, changing as the throttle is opened or closed. This statement may be correct, but the choking, or huddling of steam pressure, is at fault and steam coming up from the boiler is passing too freely into tallow pipe when throttle is shut off, so that the pressure in lubricator is not equal because steam is passing out so fast that the pressure is weaker in lubricator and allows the feed drops to flow more freely; but when throttle is opened again, tallow pipes will fill with steam chest pressure, which may be greater than pressure in lubricator, not only stop feeding for a time but will force the oil and dirt out of the tallow pipes into feed glasses, until pressure becomes as much in lubricator as in tallow pipes; then drops will commence to feed again and glass become clear. The idea is not to allow the steam to get out of the lubricator too fast, but to maintain as nearly as possible the boiler pressure in it all the time, whether the steam is shut off from cylinders or not. The inlet from boiler being not less than three-eighths (3/8) inside diameter, is very many times greater than the outlet at the discharge point of lubricator; therefore the pressure is the same and the feed must be, providing that the principles of equalizing of differential pressures are maintained. This will give success in operating the best lubricating device that has ever been known to man, which performs its duty equal to that of any other invention in these modern times of the locomotive.

The Barre Railroad, fondly called by its friends "The Sky Route," which climbs up into the azure to the celebrated granite quarries of Barre, Vt., does not seem to have suffered much from hard times. The track is nearly on end, but it extends for 26 miles, running under 79 derricks, handling the product of 72 quarries. Since March, 1889, it has carried nearly 400,000 tons of granite, besides all the merchandise, machinery and supplies required for the district; also, 103,467 passengers. A great part of the latter were tourists, who went out sight-seeing. The scenery on the route is said to be magnificent, and the ride on the steep grades, sharp curves and zigzag switchbacks is all that the most exacting taste for excitement could desire.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(42) F. H. W., Kenton, O., writes:

1. Does air retain its effectiveness if conveyed in a pipe running through the boiler? *A.*—Yes. The pressure is increased by the heat. 2. Would the blow-off cock shown on page 24 of this year, work with air when the cylinder is inside the boiler? *A.*—Yes.

(43) C. F. K., Estherville, Ia., writes:

1. If an eccentric is put in the lathe and turned down ½ inch, will that change the throw? *A.*—No. 2. What effect would it have on the travel of the valve? *A.*—None. 3. Can the speed of a valve be increased or diminished by changing the size of the eccentric? *A.*—No.

(44) J. L., New Kalmilchie, Wash., writes:

A boilermaker says that there is less danger of the plates on the lower part of a boiler giving way when there is a good head of water, because then there is less pressure on the plates. It seems to me that the pressure would be the same on the bottom as on the top, plus the weight of water. Who is right? *A.*—You are right.

(45) C. B. H., East Mauch Chunk, writes:

A friend of mine claims that the increase of lead given to a valve when the link is drawn towards the center would be the same with a straight link as with a curved one. I contend that the increase would be all on one side. Who is right? *A.*—You are. A link is curved to get as near as possible an equal lead at both ends of the cylinder. A straight link will change the equality of this lead, and will give much greater lead at one end than at the other.

(46) J. H. P., Allensville, Pa., writes:

A friend of mine claims there is such a thing as running an engine backward or forward. When the connecting rod pulls the wrist pin around above and pushes on it below, this, he says, is running the engine backward, and when it does the opposite, it is running forward. Do you think there is anything in the above theory? *A.*—When standing at the cylinder of a stationary engine, if the pin goes under the shaft on its outward stroke of the piston, it is said to run *under*; if the pin goes above, it is said to run *over*. A locomotive when running ahead runs *under*.

(47) E. R. B., Birmingham, Ala., writes:

Will you please tell us in your next issue what machinery broke on *La Gascogne*, and how it was repaired? *A.*—The piston of the intermediate cylinder broke; the engineers disconnected it and arranged temporary piping so that they could run the engine with the other two engines. This caused the heating of the boxes of the shaft, as the three cranks were arranged at 120° from each other, and cutting out one of them caused all the work to be done with a jerk; brasses had to be renewed in mid-ocean, a difficult job in a storm. *La Gascogne's* engines are quadruple expansion and have six cylinders—three tandem engines.

(48) C. A. S., Brunner, Tex., asks:

1. What is the difference between a lifting and non-lifting injector? *A.*—A lifter is located above its water supply, and has means of raising water to itself; a non-lifter must be located below, or where water will run to it. 2. Can a lifter be changed to a non-lifter? *A.*—Yes. 3. In the catalogue of the American Injector Company, it says a piece of straight pipe screwed into the overflow nozzle assists in starting the injector, especially at low steam. Why is this so? *A.*—We do not know what the American Injector Company is, or what they make. 4. Has the new "Nathan" injector an air chamber? If so, what for? *A.*—Yes. To check the noise and jar of a non-lifter when at work.

(49) T. K. J., Chicago, Ill., writes:

1. Will you tell me how to find the center of gravity of a locomotive? *A.*—The center of gravity of each piece must be found, and then from that data the center of gravity of the whole is calculated. Any good work on "Mechanics" explains the method of finding the center of gravity of bodies. 2. Will you tell me how an engine builder figures out how much a locomotive he designs is going to weigh on drivers, and if her wheel base has anything to do with it? *A.*—He figures the weight on drivers from his estimate of the weight of the various parts, such as the boiler and its attachments, the frames and their attachments. The length of wheel base will influence to some extent the weight on drivers.

(50) T. H. M., Pine Bluff, Ark., asks:

1. In what ratio does the tensile strength of steel boiler plate decrease per degree of heat applied? *A.*—Tests made by the U. S. Government showed that the tensile strength increased about 1,000 pounds per square inch from freezing up to 500° Fahr. The line of strength is horizontal from 500° to 670°, when it begins to drop rapidly. Between the temperatures 670° and 770° it decreases 2,000 pounds in strength. Then the line runs horizontal to 870°, after which it drops gradually till a temperature of 1,600° is reached, when the tensile strength of a plate which originally stood 80,000 pounds is reduced slightly below 1,000 pounds. 2. How many degrees of heat are necessary to generate 90 pounds of steam in an ordinary boiler? *A.*—About 310 heat units per pound of water. 3. Does the thickness of fire sheets affect the generation of steam? *A.*—Very little.

The Thurman Fuel Oil Burner Co., Indianapolis, Ind., report that they are meeting with great success in applying their system to boiler plants. They have lately brought out an oil kindler for locomotives, and are ready to negotiate with railroad companies to put plant into engine houses. They say that their experience in providing apparatus for the burning of oil in furnaces enables them to construct fire-kindling apparatus that are thoroughly safe and reliable.

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1 4 foot Semi Universal " "
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1 32-in.x8-ft. D. W. Pond Eng. Lathe (very powerful).
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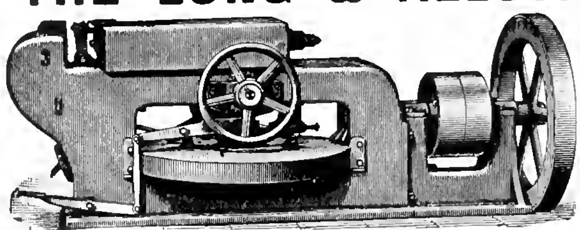

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Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

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Over 300 Sizes.

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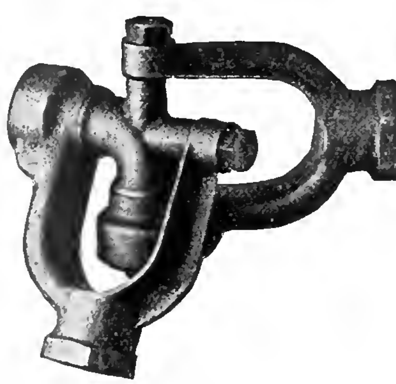

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Does away entirely with Rubber Hose for Steam Heating

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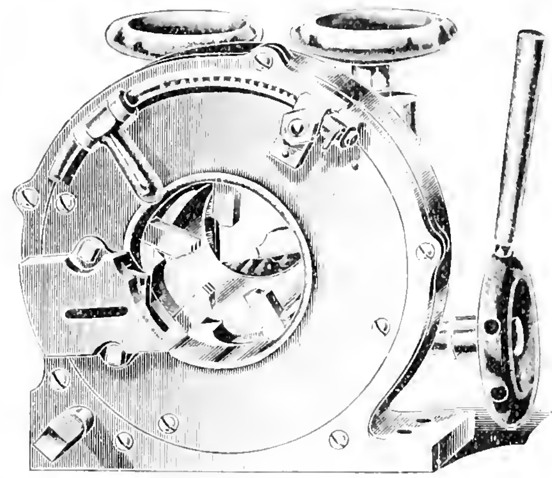

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FOR HAND, FOR POWER
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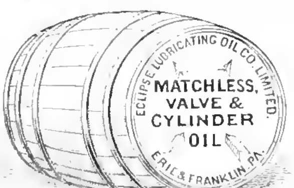

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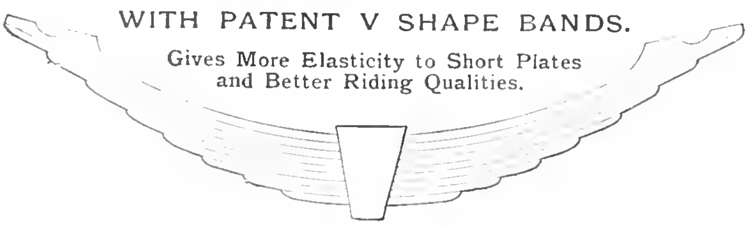

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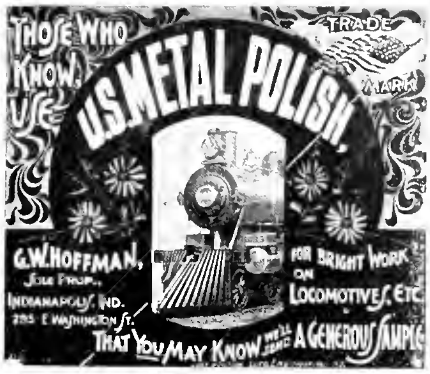

The New "NATHAN"

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For Locomotive Cylinders and Air Brakes.

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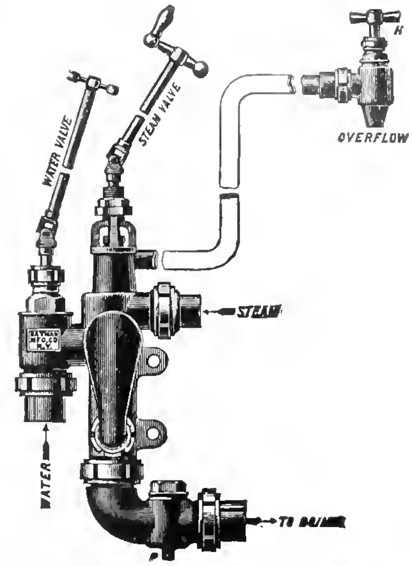

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THE screw being lubricated and protected, the Jack is always ready for instant service. Railroad men appreciate the importance of having Jacks always in good working condition. Serious delays frequently occur in getting common Jacks so that they can be worked when suddenly required in train service.

Common Jacks are frequently destroyed in efforts to make them work quickly after the screws are set with rust and dirt. This consideration alone makes the **CHAPMAN JACK** the most economical one to purchase.

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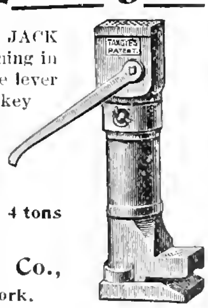
HYDRAULIC LIFTING JACK.

A GOOD, RELIABLE JACK for Lifting or Pushing in any direction. The lever is for pumping it up, the key lowers and stops it at any point, when it is again ready for lifting, saving time and trouble.



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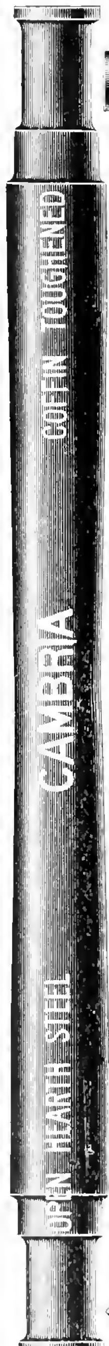

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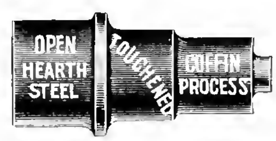

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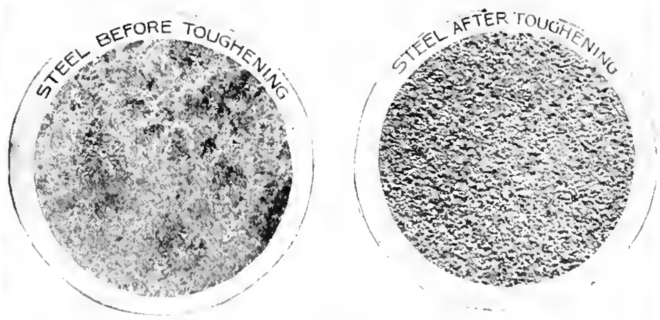

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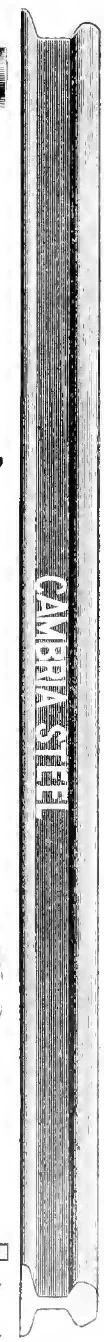

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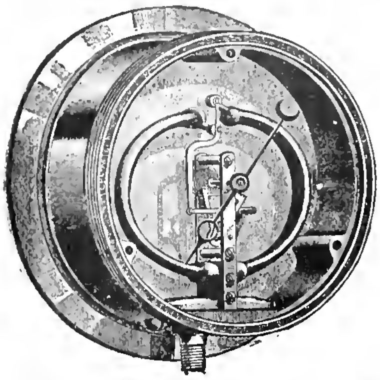
Double Bourdon Spring and Elastic Packing Ring.

SPECIAL SEAMLESS DRAWN TUBING.



Only Gauge where Movement Frame and Spring are removed from contact with back of case.

ELASTIC PACKING MAKES CASE AIR TIGHT.

No Dust or Moisture Enters.

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TABOR'S IMPROVED STEAM ENGINE INDICATOR.
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SPRINGS OF FINELY TEMPERED STEEL.
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THE MUFFLER IS A SIMPLE ATTACHMENT TO RICHARDSON'S WELL-KNOWN ENCASED

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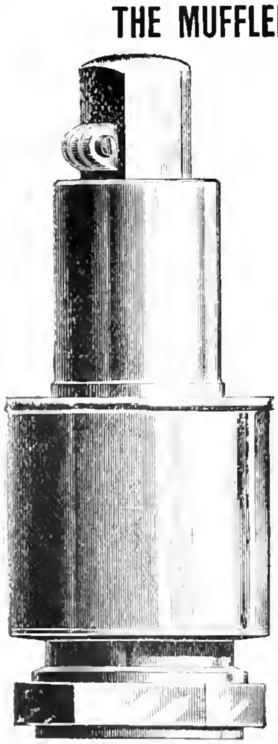

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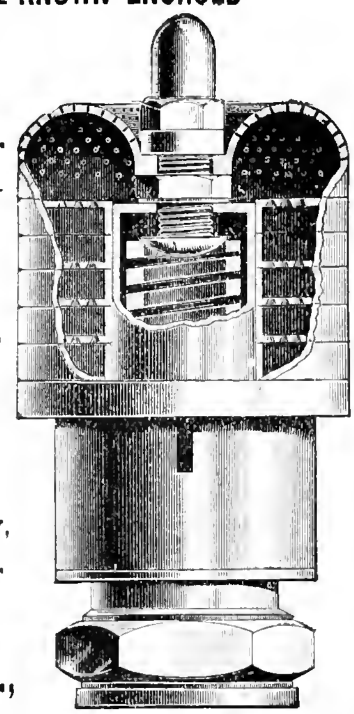
The Celebrated **999** of New York Central

IS FITTED WITH THIS VALVE AND MUFFLER, AND THE VALVE AND MUFFLER HAVE BEEN ADOPTED AS STANDARDS BY THE ROAD.

Also adopted by the N. Y. N. H. & H., the Lehigh Valley, the N. Y. L. E. & W. and the Boston & Albany Railroads.

SAMPLE VALVE AND MUFFLER SENT ON TRIAL SUBJECT TO APPROVAL.



THE CONSOLIDATED SAFETY VALVE CO.,

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It's a fact, though, that a well-known Master Mechanic and Superintendent of a R. R. in Pennsylvania reported in writing to the storekeeper, that a trial lot of ***P. P. P. Diagonal Rod Packing,*** put to a severe test on their division, outlasted what they had been using **"40 to 1."**
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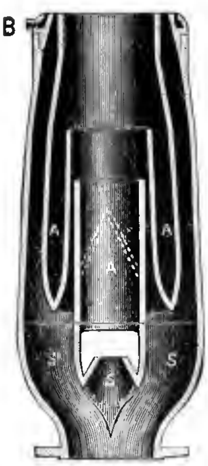
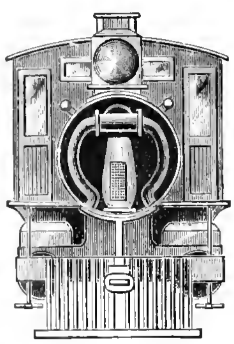
The Smith Triple Expansion Exhaust Pipe.



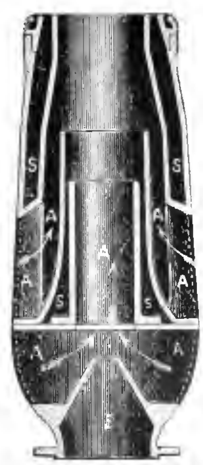
FRONT VIEW.

THIS DEVICE is the invention of JOHN Y. SMITH, the originator of the Smith Vacuum Brake. In the cuts of the Front and Side Views shown herewith, "AA" represent Air Passages; "SS" Exhaust Steam Passages, and "B" an Annular Blower forming part of the Nozzle.



It is an entirely new departure in the construction of Exhaust Pipes for Locomotives. Its distinguishing features are that the exhaust steam is not restricted after it leaves the cylinders, and the gases and heated air in the smoke arch are mingled with the exhaust steam in the exhaust pipe. The exhaust steam is thus superheated and expanded and a powerful, prolonged, pulsating blast is created, which keeps the fuel in a constant state of agitation, and produces more perfect combustion.

Some of the beneficial results obtained are: *Reduction of Back Pressure to a minimum (area of nozzle opening as large as the exhaust port); prevention of ejection of sparks from smoke stack; almost complete absence of noise from exhaust; prevention of formation of clinkers in firebox; large saving of fuel.*



SIDE VIEW.

By the elimination of Back Pressure we have demonstrated the fact that the power of engines has been increased to be able to pull from thirty to sixty tons more than with any other form of exhaust pipe.

The pipe can be used with either straight or diamond stacks, in long or short front ends, and on locomotives burning hard or soft coal, wood or coke.

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The knuckle may be thrown open for coupling by the hand rod at the side of the car, rendering it unnecessary for the trainmen to go between the cars to open the knuckle.

M. C. B. Type. **The Strongest and the Only Safety Coupler.** **New York Office: 49 Wall St.**

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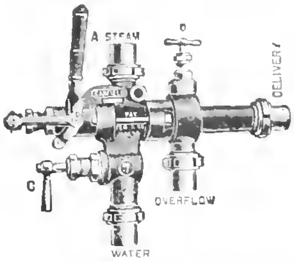

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Has Widest Range of Capacity.

Handles Warmest Water.

Easily Manipulated. Positive Action.

Economical to Maintain.

Interchangeable with Other Standard Machines.

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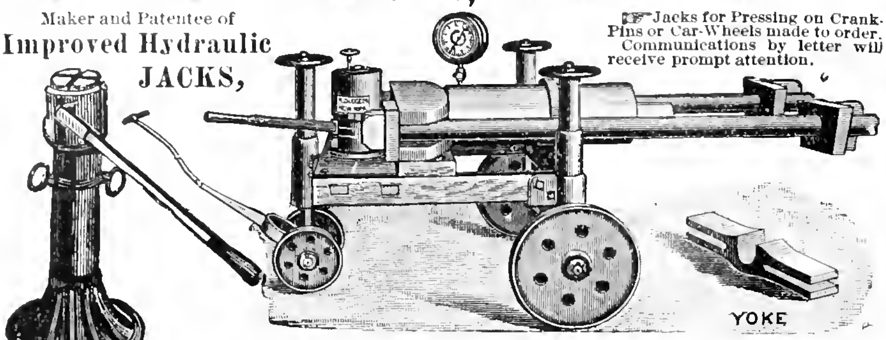
Jacks for Pressing on Crank-Pins or Car-Wheels made to order. Communications by letter will receive prompt attention.



Punches, Roller Tube Expanders and Direct Acting Steam Hammers.

THE
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MANUFACTURERS OF
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WROUGHT IRON PIPE OF SUPERIOR QUALITY.

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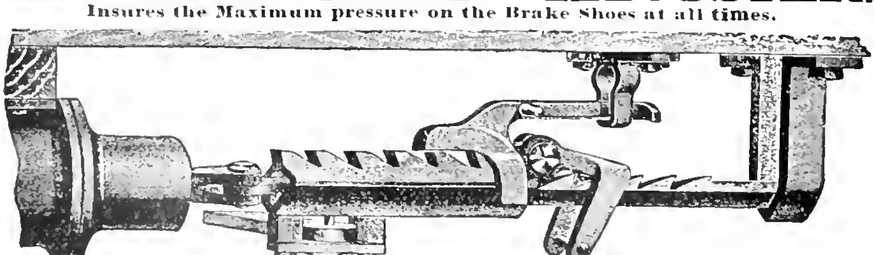

Manufactured by **PRATT & LETCHWORTH,**
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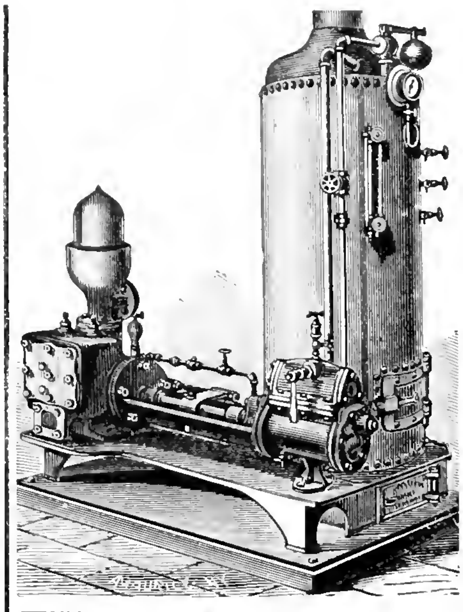

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Complete with Boiler.

THE A. S. CAMERON
Steam Pump Works,
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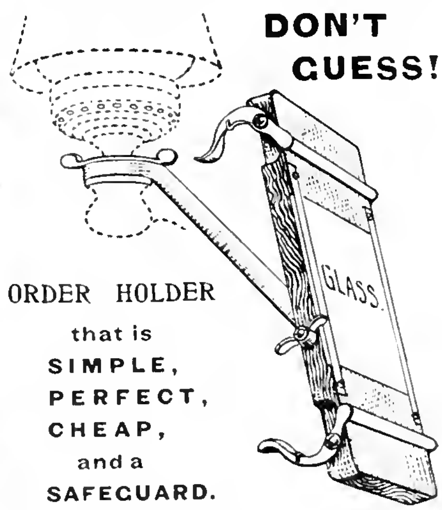
DON'T GUESS!



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SIMPLE,
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You live on your engine, have the best and safest tools.

FORGOTTEN ORDERS have cost many lives—Is yours worth HALF A DAY'S PAY?

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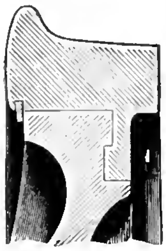

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BOLTLESS STEEL-TIRED WHEELS

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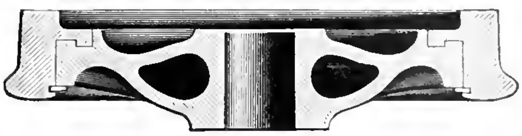

A Continuous Circumferential Fastening. Simple, Safe, Economical.

CHILLED IRON WHEELS

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Cylinder Packing Rings.

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For Chilled Iron Wheels,

Outwear from 4 to 6 ordinary Shoes and enhance mileage.

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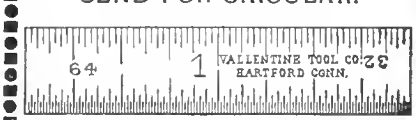

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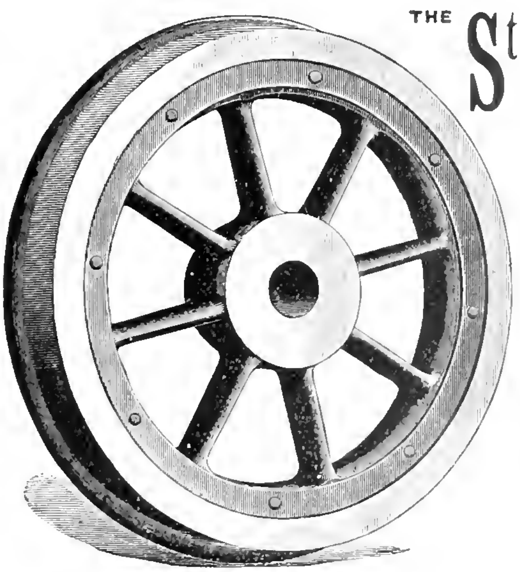

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STEEL TIRES

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Wrought Iron Centres.
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Is now prepared, to fill orders, at an hour's notice, for One or One Thousand Sets of

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Locomotive Equipments, Direct Steam, Commingler, Storage and Multiple Circuit Systems. Cars equipped 6,100. **SEWALL COUPLERS** sold 55,617; the Standard in U. S. and Canada.

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Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch." In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

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Also heavy pattern for marine purposes. In long tried use on Steamboats, Locomotives, Refineries, Rolling Mills, U. S. Cruisers. **None genuine without our name,** which is cast in the shell. **Specify and insist** upon getting "Lunkenheimer's." New Catalogue of Superior Steam Specialties will interest you. Gratis upon request.

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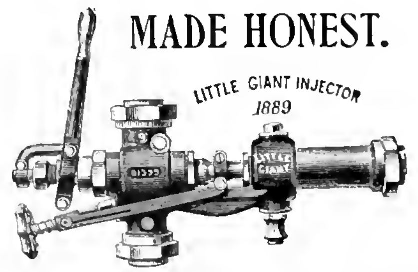

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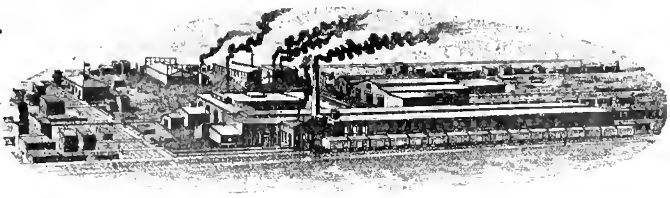

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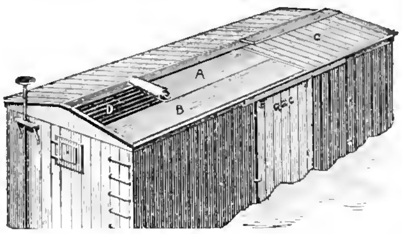

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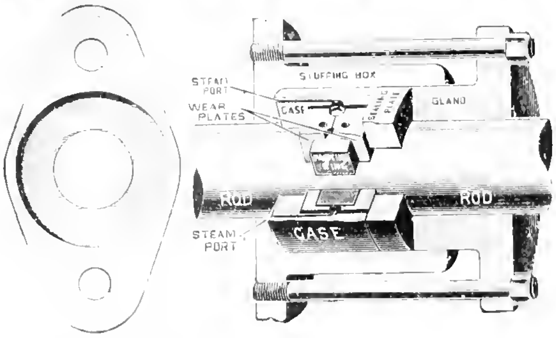

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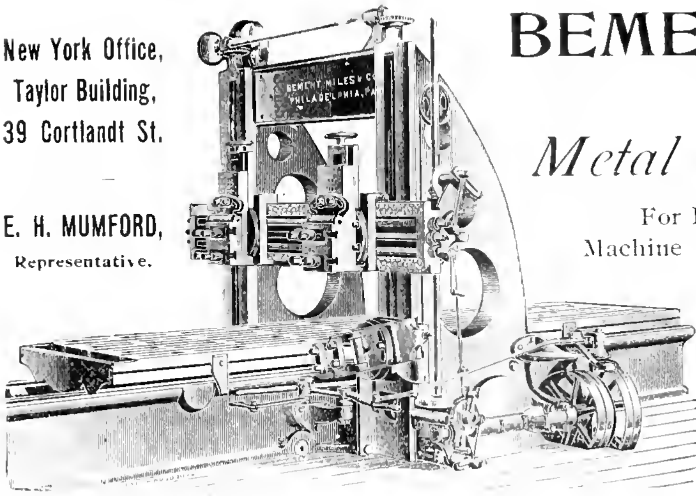

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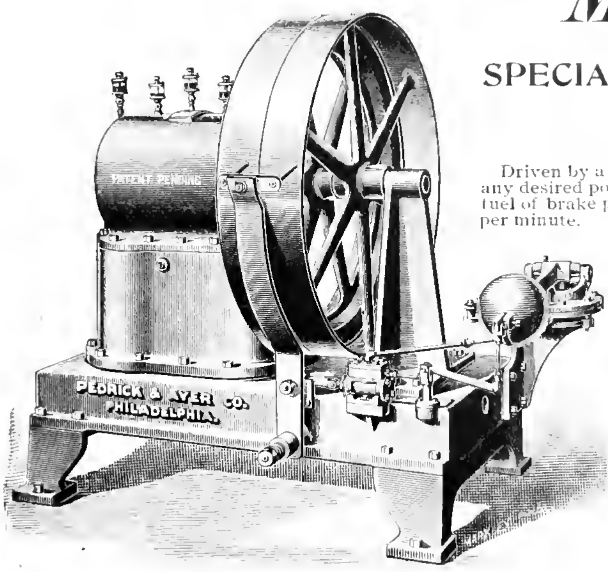

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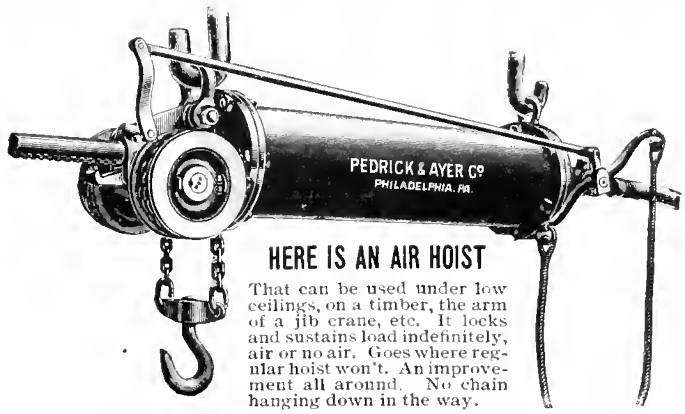

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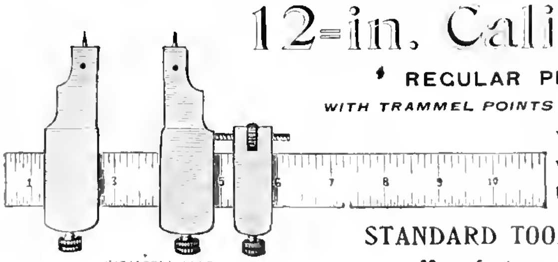

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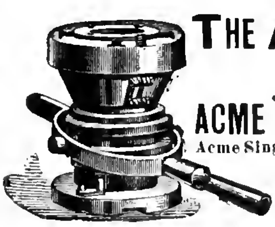

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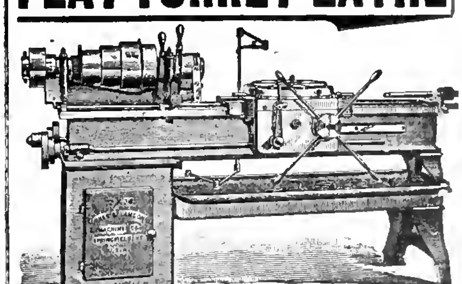

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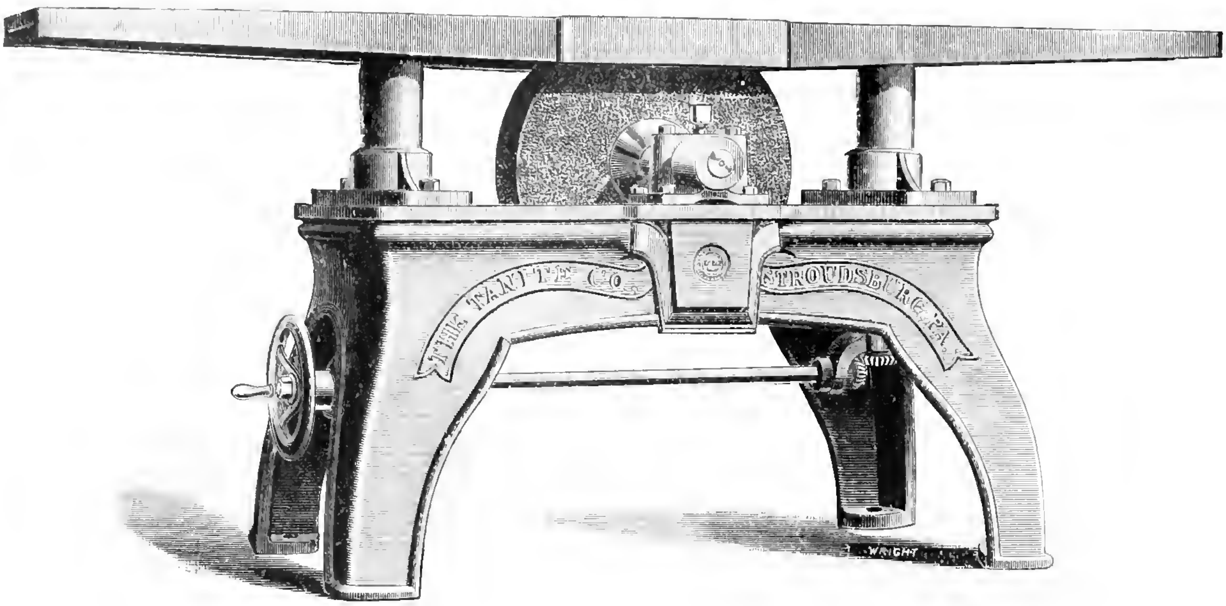

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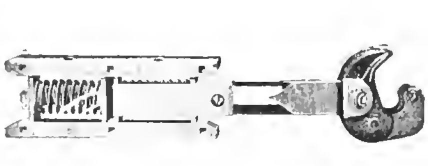

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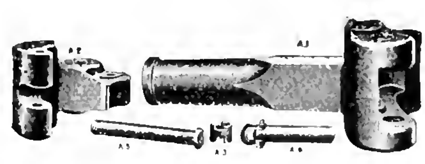

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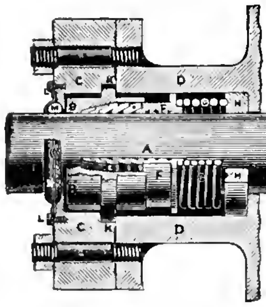

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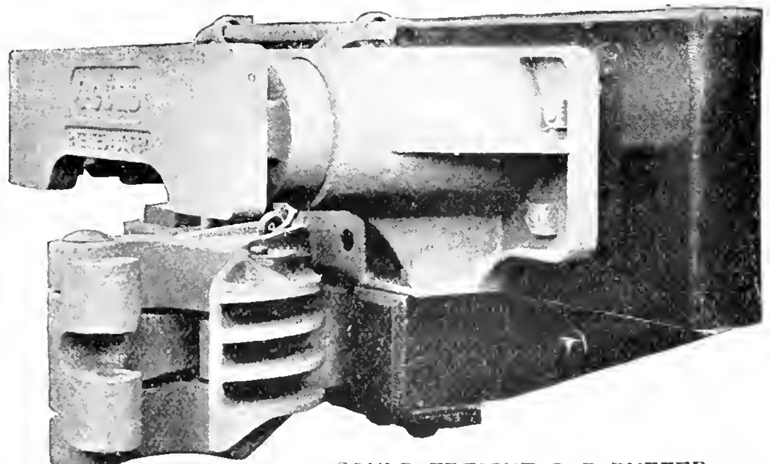

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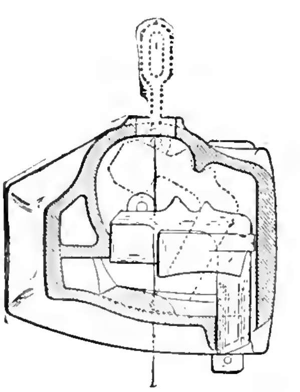

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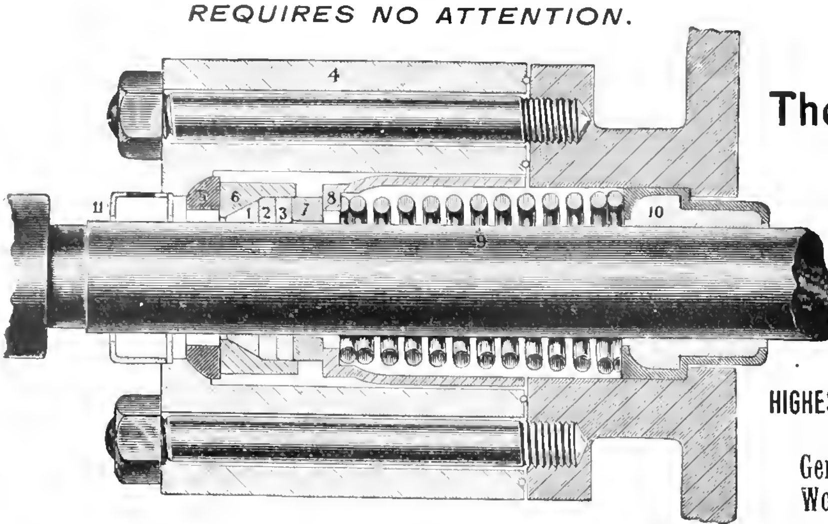

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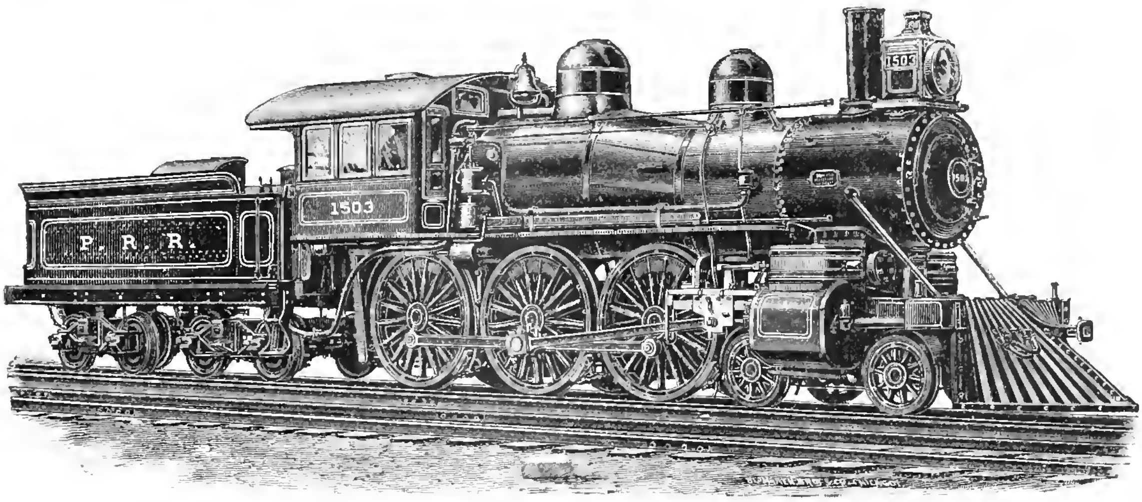

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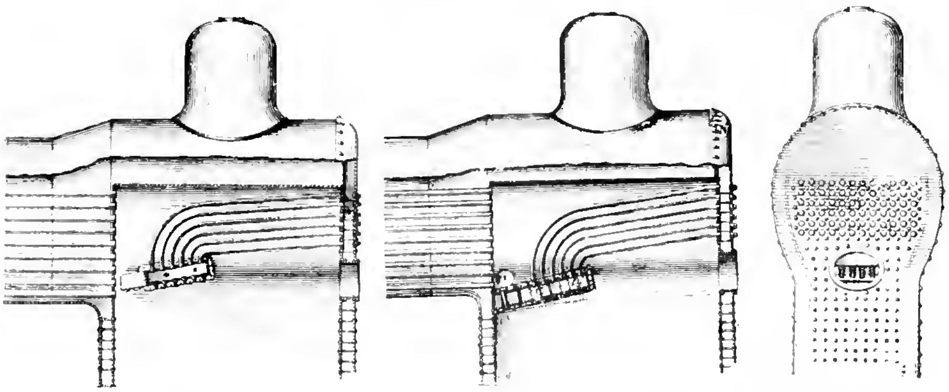

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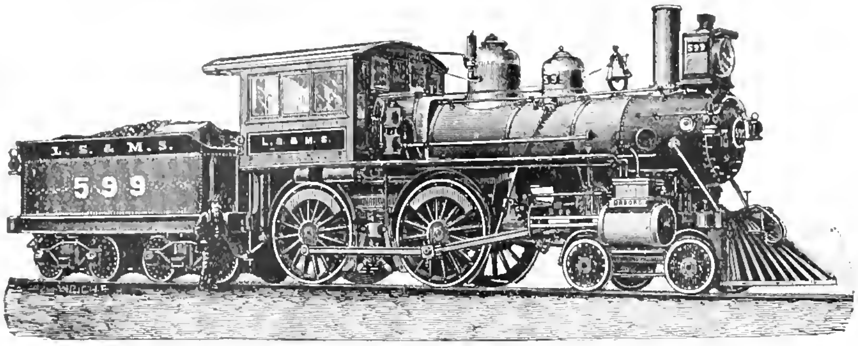

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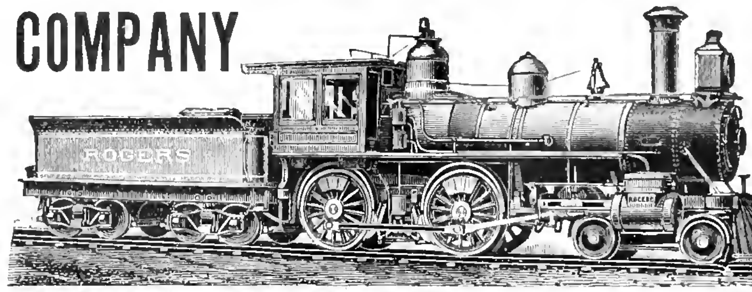

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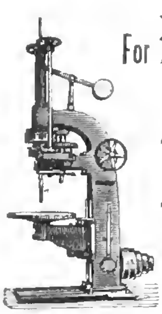

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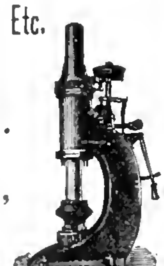

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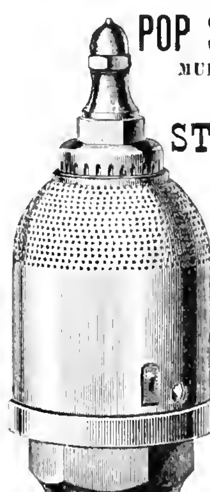

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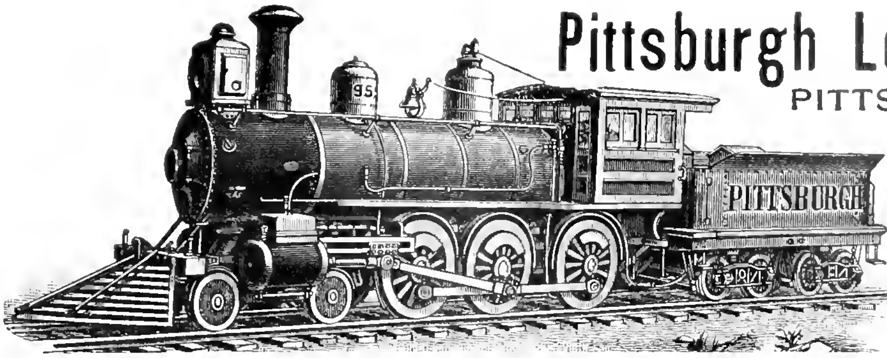

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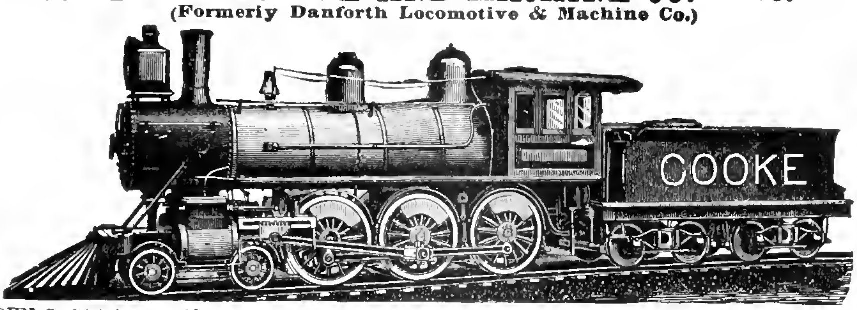

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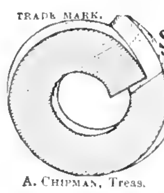

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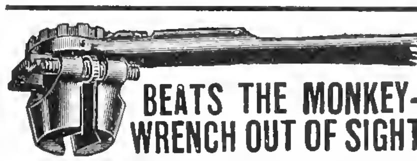

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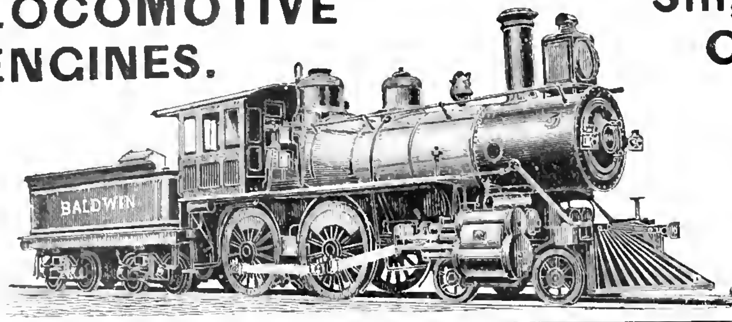

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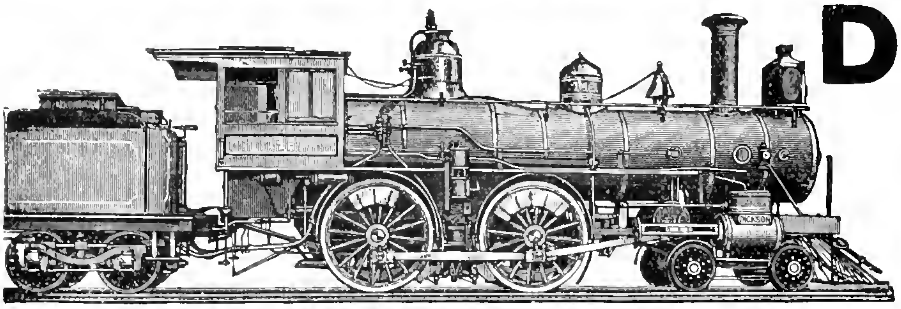

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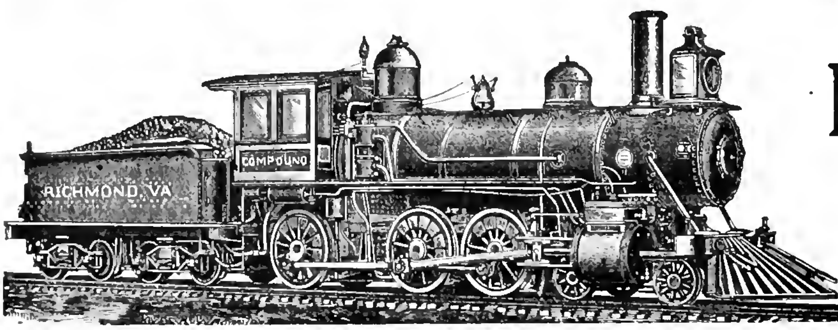

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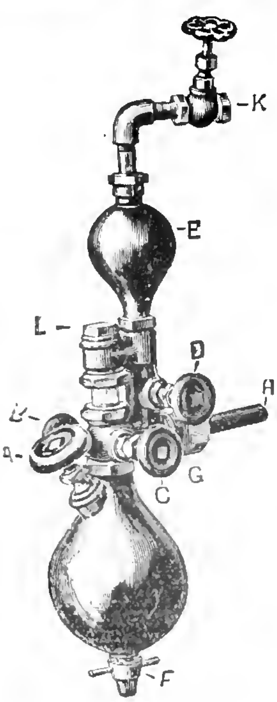

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Continued on page [illegible]

"Keep a-jumpin'," said the Frog.

Frederick Fosdick.

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Improper Steam Piping, Frederick Fosdick.
An Engineering Experience, S. Ashton Hand.
Pitch and Strength of Gear Teeth, Samuel Webber.
Recollections of the Steam Engine Indicator (2), F. F. Hemenway.
Designing Stationary Engines (6), Theo. F. Scheffler, Jr.
Among the Shops, Fred H. Colvin.
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Notes from Different Workshops, A. Learner.
Systematic Tool Making, Warren E. Willis.
What Mechanics Think.
Various Short Articles.

Nearly every one has heard of the two frogs who fell into a tub of milk. "I'm a goner," said one. "Not much," said the other, "keep a-jumpin' and see what comes of it." The first frog refused the advice and met an early death; but the second frog kept a-jumpin' all night; and in the morning, the milk having been churned into butter, jumped out of the tub and went about his business feeling none the worse. In spite of hard times and dull business we have jumped the circulation of Machinery up to 15,250 copies, and the advertising up to nearly $10,000 a year—and we are still a-jumpin'. Reader, is the moral plain?

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Volume 8. Number 4.

A Practical Journal of Railway Motive Power and Rolling Stock.

Locomotive New York Engineering

April 1895.

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From London to Warsaw.

[EDITORIAL CORRESPONDENCE.]

After rambling about the British Isles for several weeks, I found myself in London looking towards far St. Petersburg and cogitating on how I could get there, see whatever railroad novelties were to be found, and get back to Havre in time for my boat, visiting en route all the leading attractions. When a traveler is situated as I was, he is certain to find out the overwhelming inclination of people to give advice. Twenty different routes appeared to be recommended by veteran travelers and by others who had never crossed the English Channel, but considered themselves perfectly competent to give advice. Every one gave urgent reasons why his or her advice should be followed.

At this time, too, I discovered the intense antipathy that the average denizen of Great Britain has to Russia. "Going to Russia!" my friends would exclaim with a catch in their breath, and then they would regard me with looks of compassion and others that mutely said, "He used to have a little sense, but now ——, well, he has been living in America."

My hesitation about a route was settled by my traveling companion, who decided in favor of the Hook of Holland. That route gives you a night on the North Sea, but it is a pleasant change from the confined trains. The Hook of Holland is a tongue of land at the mouth of the Rhine, and has a close family connection with our own Sandy Hook.

On getting ashore, we find the railway station on the wharf and the train ready to start, but time is given for breakfast. One of the most striking things in Holland is the absence of excitement. Nobody appears to be in any hurry. The din and bustle of the ordinary railroad terminus is absent here. There is no liveried official shouting to hurry up with baggage, no yelling "All aboard!" no train boys clamoring to sell papers and fruit, nothing but quiet deliberate movements.

I expected to find some novelties in the railroad rolling stock of Holland, but I was mistaken. The locomotives and cars were very much like those of the Great Eastern which brought us to Harwich, only cleaner and evidently in better condition. The locomotives were inside connected, and had been built by Neilson & Co., Glasgow; the cars were of the ordinary compartment style.

While touching on the subject of cars, I might mention that in Britain, Germany, Russia, Austria, Switzerland and France, countries which I traveled in, I noticed a change going on which will eventually do away with the compartment car with doors at the side, and give the traveling public vestibuled cars entered at the ends. In Germany, the cars in through trains were rather mixed in appearance, some of them being of the old compartment, side-door type, while others were vestibuled, with a passage through the car lengthwise. This passage is always at the side with small compartments opening into it. The government of Austria have decided that no more side-door compartment cars shall be built, and that the existing carriages must be changed to the vestibule form as soon as practical. The same practice is making rapid progress in the British Isles, and nearly every railway company has its "corridor" trains, which admit of intercommunication between cars. One of the finest trains of this character which I traveled on was on the Caledonian, of Scotland. The other countries in Europe are slowly moving in the same direction.

The railroad managers do not view the movement towards vestibuled cars with favor, because the change involves more dead weight per passenger carried, but they cannot help themselves. Some of the more enterprising companies began providing the superior accommodation, safety and comfort found in the corridor car, and the traveling public is now urging that nothing else should be used on through trains.

The cars are what we would call short, ranging from 30 to 40 feet between buffers; but they are much longer than the older type of the compartment car. Some of them are carried on trucks, but three pairs of wheels form the most common style of running gear. I found an extraordinary thing in the Eastern Railway of France. There is not a single car on that system carried on more than two pairs of wheels. They have cars weighing about 36,000 pounds empty, with a wheel base of 24 feet, that are carried by two pairs of wheels. There was a serious accident to a passenger train on that system when I was in Paris, through the breaking of an axle. It is surprising that the government, which keeps a close supervision over railroads in France, does not insist on better running gear for these heavy cars. The company runs the fastest trains found on the Continent of Europe, and takes the Orient express, the most famous train on the Continent, through France.

We left the Hook of Holland on a Sunday morning, and had the pleasure of seeing the Dutch people out in their holiday attire. The people congregated at the stations to see the trains, and their quaint costumes and ruddy faces made up picturesque sights. I was reminded at every hand of a humorous description of a visit to Holland which Oliver Goldsmith wrote 130 years ago. He said that when a Dutch belle wished to make herself particularly attractive she put on thirteen petticoats, and a heavy swell of the other sex wore twelve pairs of breeches. The diameter of some of the people we saw at stations indicated that the fashions of Goldsmith's time are not entirely extinct.

The country is interesting as an example of what stern industry can do to overcome

adverse natural conditions. A great part of the country has been torn from the ocean by stupendous toil, and strenuous labor is necessary to maintain possession. Every rood not devoted to roads, canals or ditches is cultivated or used as pasture. Neatness, cleanliness and thrift are everywhere apparent, the cows browsing in the rich fields being nearly all covered with blankets to protect them from sun and storm. The ordinary run of village and farm houses have great sloping roofs, with eaves that reach nearly to the ground. I was puzzled for a while to understand why the people were so lavish with roofs, and afterwards learned that their garrets are used as cellars. They cannot dig cellars, because the water is everywhere almost close to the surface.

There was nothing novel about the Dutch rolling stock or roadbed. They appear to have adhered very closely to English forms and methods, with the exception that chairs are not used under the rails. Signals and interlocking are in use at all stations, and such accidents as collisions are very rare. This is not surprising, for the trains run slowly, passenger trains are provided with good air brakes, and absolute block signaling is in general use.

When we reached the German connecting line, which took us through Hanover, we found very little difference from the appearance of railroad appliances in Holland. There is a decided difference in the personnel, however. Germany glories in military pomp and circumstance of war, and railroads are operated with military precision and display. It does not tend to accelerate the movement of trains, but it makes trifling duties seem important, and places the officials on pedestals of dignity. Nobody seems to be in a hurry, and, therefore, the delays which result from the slow movements of the human mechanism do not matter. The stations swarm with men dressed in an array more imposing than the garb of our drum-majors. Conspicuous among the greatly dressed officials is one with a scarlet cap. He touches the button that sets all the others in motion. After you begin to wonder why the train does not start, since everybody is seated and all the doors are closed, Red Cap, who is the stationmaster, raises his hand and shouts and a station bell rings. Then another man wearing a helmet, gives a signal to one whom we supposed to be a major-general, but who was really the conductor. This important personage then toots a horn and waves to the engine driver. The latter looks back and salutes, then he toots his whistle twice, looks back again, and then starts the engine with great care and deliberation.

We stopped a few days in Berlin and then proceeded eastward. It was my intention to go to St. Petersburg, but I found that the time to go there and back was out of all proportion to the distance, and that I could not safely go farther than Warsaw. I had reason to be glad afterwards that I did not attempt to make a longer journey. We accordingly started for the birthplace of Thaddeus.

Nothing of any consequence happened until we got to Alexandrowa, the frontier station of the Russian Empire. A brother accompanied me, and he did not have a passport. Persons in Berlin had said that the use of a few gold pieces would render a passport unnecessary, and the guard of the train we traveled on from Berlin also said that a traveler could get into Russia without a passport.

When the train stopped at Alexandrowa, a crowd of officers rushed into the cars shouting, "Passports!" My brother not being able to produce the important document, was escorted out of the train under guard and directed to return from whence he came, and no one would listen to excuses or explanations. The others were all marched into a house for the examination of baggage, and the search was the most thorough I had ever seen, but that was because I had never been in Russia before. In my bag there was a copy of Bradshaw's Continental Guide, which has the British royal coat-of-arms on the cover. When the examiner saw the coat-of-arms, he made a grab at the book as if he had found a dangerous publication, and carried it to his superior for examination. The latter evidently knew the book, for he gave a contemptuous grunt, and the subordinate brought it back crestfallen. He could find nothing more in my bag of a suspicious character. Next to me was a German who had a kodak. Here was something suspicious. The officer insisted on the German opening the kodak, and the owner protested that opening it would ruin his pictures; but the officer was determined to see the contents. I never knew how the matter was settled, but I noticed in the train afterwards that the German did not have his kodak.

When traveling in a foreign country, an observing man naturally watches to note habits and practices different from what he is accustomed to at home. In Europe, the difference in habits and manners is really very slight. The cars, of course, are different, but the people met in the trains are, as a rule, very much like the people met in Pennsylvania. In the whole circuit which I made, from Paris to the north of Scotland, from there back through England, Holland, Germany, Austria and back to Paris, I could see little in the outward appearance of the people to indicate that they were worse clad or worse fed than Americans. It is well known that the feeding is very sparing in some districts, but this is not apparent from the looks of the people. The scenery from Berlin to Warsaw is not unlike what one passes through in going from Buffalo to Indianapolis.

One thing which struck me in the trains in Poland was the silence of the travelers. The people did not seem free to express themselves before strangers.

Another thing which impressed me was the deliberate speed of the trains. I kept thinking about a story the J. P. tells about a train in Colorado. They were climbing a long mountain grade, and the engine was steaming badly, the flues were leaking and the coal was bad. The conductor sent a brakeman forward to ask the engineer if he thought that he was pulling a funeral, with other pleasantries. When they got over the summit, the engineer let the train drop down at a frightful speed. The brakeman was sent forward to ask why the engineer was acting so recklessly. In reply to the question, where was he going at such a mad pace, the engineer answered, "Tell the conductor, sonny, that I am going home from that funeral."

The Polish train had a decidedly funereal impression—you felt that the people were just going to talk about the deceased; but there never came the stir of going home from the funeral.

When I got to Warsaw, my first care was to find out if there were any railroad shops worth visiting. The hotel manager informed me that there were very large and fine shops. The next thing was how to gain admittance, and how to make myself intelligible to the officials. I have been repeatedly told that travelers in Europe can find people in all the large hotels who talk English. This is a mistake. I did not find but one man in Warsaw who attempted to speak English, and his efforts were painfully contracted.

I asked the hotel manager if there was an interpreter about who understood English, and he assured me that there was one who talked all the European languages. When the fellow was sent for, he assured me that he talked every language except English. I then thought of the American Consulate, and went there. The consul was pleasant enough, but his English was something like that of an Italian sailor who had made a voyage on a British ship. The sailor was asked if he talked English, and he said, "Si, me grub time, God damn." That was his whole vocabulary. These were the words that left the strongest impression.

The consul was very much puzzled to understand why I should want to see through a Polish railway shop, and he could not be convinced that I did not want to sell something. On the whole, he regarded my story with suspicion, and his face told me plainly that he considered me an accomplished liar. He was inclined to give me no assistance until I produced certain letters addressed to Minister White, which described me as editor of one of our most influential engineering journals. He could read English much better than he could talk, and the letters impressed him. It ended in his sending a young man along with me to the railway shops. This youth talked French fluently, but not a word of English, although he was evidently a clerk in the consulate.

Gaining admission to the shops was a

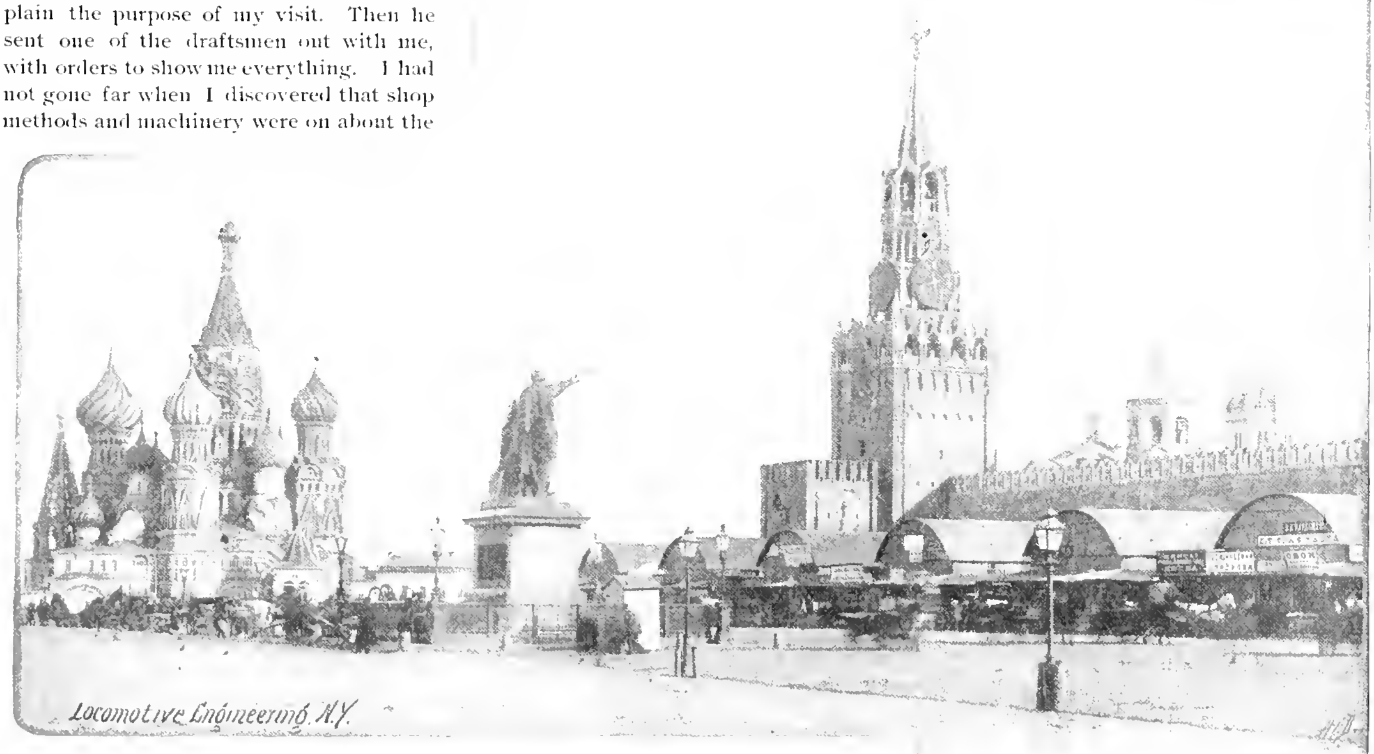
formidable proceeding. I wanted to reach the chief engineer, who is the head of the rolling stock department. I had interviews with about five subordinates before the top was reached. The chief engineer received us very kindly. I proceeded to intimate, through my guide, that I was an American engineer, and that I wanted permission to go through the shops. The chief understood what I said, and answered me directly in French with the question, Did I want to sell them anything? He was as much mystified as the consul about why I should want to visit his shops, unless I expected to sell them something. With a good deal of difficulty I managed to explain the purpose of my visit. Then he sent one of the draftsmen out with me, with orders to show me everything. I had not gone far when I discovered that shop methods and machinery were on about the same plane as those found in Scotch shops thirty years ago.

The machine shop and erecting shop are under one roof. There are some good cranes for lifting heavy weights, but the labor-saving appliances are remarkably scarce. There was very well finished work turned out, but the skill of the workmen deserved the whole credit. The machine tools are all antiquated, and consist principally of lathes, planers and drill presses. If the chief engineer in charge there could visit some of our good shops, or even some of those in Germany, he might go home and introduce a revolution into his shop that would reduce the cost of production 25 per cent. But revolutions are not popular under the Russian rule, and workmen are not dear as numbers go; so I suppose they will continue on in the even tenor of their way, neglecting tools but cultivating skill among the mechanics.

I expected to find traces of the stamp that Winans and other American designers had put upon Russian rolling stock, but there was nothing of it to be found in Poland. The locomotives and cars are extremely diverse in design and proportions, but there is nothing American about them. They have adhered very closely in the past to the older German forms, and most of the engines and cars were built in German shops or under the supervision of men having German training. The young engineer who went round with me intimated that they were working toward standard forms of locomotives and cars, and pointed out the types they were working to. If they carry out the plan indicated they will have outside-connected engines and small corridor cars, both closely conforming to Austrian types.

There were many curious things to be seen in the ancient city of Warsaw, and the trip was not altogether lost; but as a pilgrimage to look at railway machinery in a strange land, it was a dismal failure.

A. S.



In Moscow, Russia.

The History of Counterbalancing Driving Wheels.

The following interesting account of what has been done in the counterbalancing of driving wheels is taken from a paper by Mr. R. P. C. Sanderson, read before the Southern Railway Club:

The first proposal ever made to overcome the unsteady motions of locomotives due to their being unbalanced, by the applications of counterweights to the driving wheels, was advanced by George Heaton in 1831, but up to 1834 only the revolving weights were considered. In this year J. G. Bodmer patented the application of two pistons of the same stroke to work in each cylinder, operating upon a double crank on the axle in opposite directions; the avowed object being to make the disturbing action of one piston counterbalance that of the other, and thus obtain perfect equilibrium. In 1836, Mr. Weallens brought out a four-cylinder engine, which was the prototype of the well-known Shaw engine.

Mr. Fernihough was the first to propose and carry out the balancing of the reciprocating parts of a locomotive by counterbalancing weights applied to the wheels. This was done in 1845 on a number of locomotives. In 1847, George Heaton proposed to use a double crank, and to have a connecting rod attached to the outer crank pin; which connecting rod was to give motions to weights sliding on guide bars that would thus move in opposite direction to that of the piston and appendages, neutralizing the disturbing action of these. This plan was used for some years in England—a precisely similar plan to that recently advocated by prominent marine engineers to reduce the destructive vibrations in high-speed torpedo boats by the use of bob weights.

In 1847, Mr. Haswell brought out an engine similar to the Weallens engine of 1836, and almost exactly like the recent Shaw and Ball locomotives, which engine was in regular service on the Austrian

State railroads from 1847 to 1873. Up to 1847, while many locomotive designers understood that the reciprocating action of the pistons, rods and crossheads was the cause of the disturbance, the nature of their action was not clearly understood; but in 1848, Mr. Nollum, of the Holstein railways, in Germany, analyzed the subject carefully and correctly, then made some rough experiments in applying what he calculated should be the correct counterbalance weights to some of his locomotives, and satisfied himself that he was correct in his assumption.

In 1848, M. Le Chatelier, in the workshops of the Orleans Railway, in France, suspended a locomotive by heavy ropes, so that the wheels were entirely clear of the rails. A pencil on the end of a light arm was attached to the front bumper beam at one corner, under which pencil, sheets or cards could be held.

When the engine was set in motion, the pencil would describe a diagram on the card which would give the exact amount of lateral and fore-and-aft disturbance. Experiments were made with no counterweights at all, and with different amounts, ranging from enough to balance the revolving weights only, up to more than enough to fully counterbalance the whole of the reciprocating weights; these were repeated for speeds varying from ten to thirty-five miles per hour, and it was found that without any counterweights at all in the wheels, the movement was about ⅜ of an inch laterally and fore-and-aft; when balance weights were applied sufficient to counterbalance all the revolving weights and 42 per cent of the reciprocating weights, the movement was reduced to $\frac{3}{32}$ of an inch, and when the weight was increased so as to provide counterbalance for all the reciprocating parts, the lateral and fore-and-aft movement ceased, but the vertical or up and down movement was increased materially. These experiments were repeated with a six-wheel coupled freight engine by M. Le Chatelier, with precisely similar results. They were again repeated on the Northern Railway of France, with a six-wheel coupled engine.

Similar tests have been made at different times and places in England with a variety of engines, and in this country such tests have been made by the Pennsylvania Railroad and by the Chicago, Burlington & Quincy with actual locomotives; also by Professor Lanza, of the Boston Institute of Technology, with models. The results obtained from all these experiments confirm the deductions made by Le Chatelier, a very full description of whose experiments is published in D. K. Clark's "Railway Machinery." Considering that it is forty-two years since Le Chatelier's experiments were made public in the English language in Clark's book, and that practically nothing new concerning the principles involved has been brought out since then, it would seem that your committee were dabbling in ancient history to refer to the subject at this time.

WENT IT ALONE—WISCONSIN CENTRAL ENGINE THAT BACKED UP INTO A YARD 40 MILES AN HOUR WITHOUT ENGINEER OR FIREMAN.

Keep the Air Pump Simple.

Discussing the subject of simple and compound air pumps for brake service, at a meeting of the New York Railroad Club, Mr. R. A. Parke described the experiments made by the Westinghouse Air Brake Co. to find out the relative merits of the two types. The outcome of the experiments was that the company decided to make their standard pump simple, with cylinder 9½ x 10-inch stroke. This was found to be more adapted for the work than the compound, as it is much simpler to fit up and less likely to fail from neglect or otherwise.

The average railroad man cannot afford to ignore the effect of carelessness and neglect upon the mechanism applied to rolling stock. On some roads the mechanism is so intelligently cared for that a complex article will give good service, but on the majority of roads the device which will work most persistently under neglect and bad usage will render the most efficient service. In some cases an inferior article will be more satisfactory than one of much greater intrinsic merit, merely because the former is susceptible to neglect. There was never a better injector in careful hands than the Sellers, 1876, but it never attained general popularity, because it did not thrive under bad treatment.

It is a mistake to introduce any complication on the air pump, or to increase its first cost, for the purpose of saving steam. The amount of steam used by the air pump is so small, in proportion to the whole used by the locomotive, that a saving of 50 per cent. would not be perceptible. A saving even to that extent would be of little real value, because the air pump is generally working hardest when the safety valves are blowing. The steam that is used by the air pump at stations, entering, stopping, or slowing points, and on descending grades, would be wasted by the safety valve if it were not used by the air pump.

In some very careful engine tests made by Mr. George H. Barrus on the Baltimore & Ohio, it was found that the whistle used about the same volume of steam as the air pump. It would be considered ridiculous to raise an agitation against the whistle on account of its cost in the use of steam. It has never been demonstrated that a locomotive hauling an air-braked train consumes a pound more coal than the locomotive that has no air pump while hauling the same weight of train. All arguments are in favor of keeping the air pump as simple as possible; there seems to be no possible compensation for increasing the complication and the first cost.

On the C. & W. M. and the D., L. & N. —under the same management—they have many engines where the steam enters the chest from the side next the arch. They have had good results by changing the oil pipe connection from the top of the chest to the side, letting the oil enter with the steam. It was noticed with the old plan that valve and seats were cut most on the end toward the arch, and it was believed that the entering steam blew the oil away from that point. The true way to lubricate valves and pistons is to lubricate the steam entering them.

About as good a pilot plow as can be used, especially for fast engines, is made by filling between the slots with wood; but this is bad when there is no snow, as the large solid area of the pilot stirs up dirt and cinders that are destructive to bearings. On the C. & W. M. they put a straight piece of stack netting inside the pilot; this lets plenty of air through it, but in snow fills up at once and forms a solid pilot.

No more back numbers for 1894—all sold.

BLOCK SIGNALING

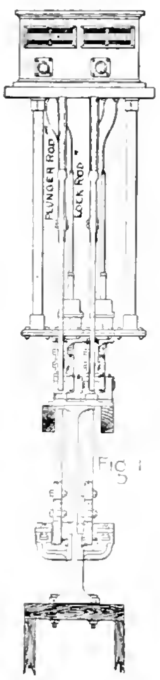
Construction—The Controlled Manual Systems.

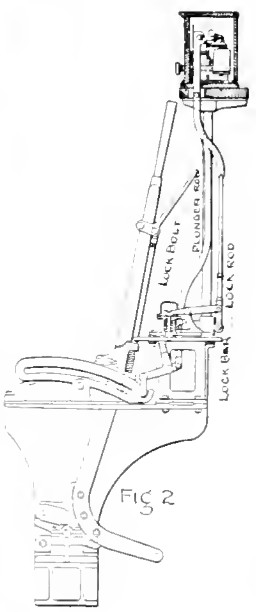
[FOURTH PAPER.]

By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

With these systems, as their name implies, the labor of two men, one controlling that of the other, is required to clear the signal for a train to enter the block. The work of "clearing" the signal is done by the man at the entrance of the block, the same as with a telegraphic system, but the controlling power, or the actual permission to so clear the signal, is given only by the man at the end of the block.

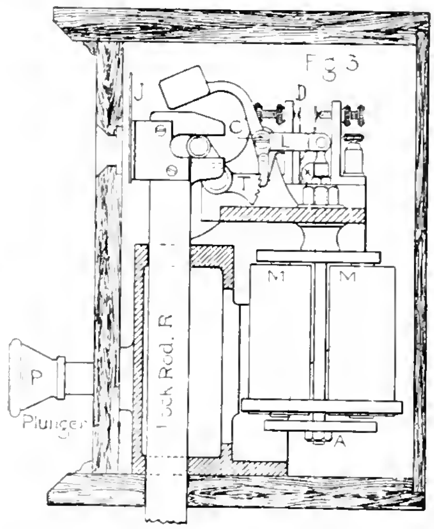
The arguments used in favor of this method of operation are, that where two





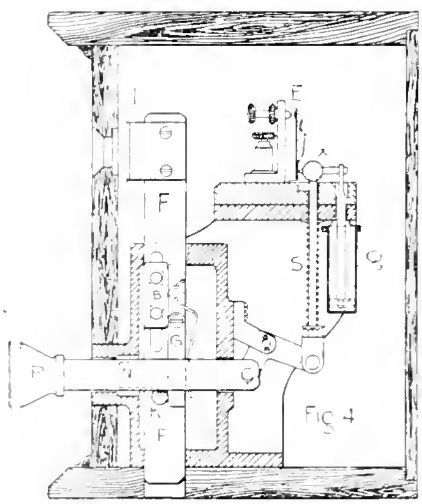
men are required to work in this way in connection with each other, they are less likely to make mistakes, each acting as a check on the other; that placing the control of the signal in the hands of the man at the end of the block is a much more reliable and certain plan of operation, as he will know whether a train admitted had actually passed out of the block; that by making it impossible, by means of the track circuit, for the signal to be again cleared until after the train admitted has passed out of the block, all chance of a mistake being made by either operator is eliminated, and the indications given by the signal can be relied upon as showing the actual condition of the block.

The arrangement of the several parts of a Controlled Manual system is somewhat more complicated than are those of the telegraphic systems, and while a description of the instruments sufficient to explain the operation of such a system has already been given in a previous article,



the special parts peculiar to each system have yet to be described.

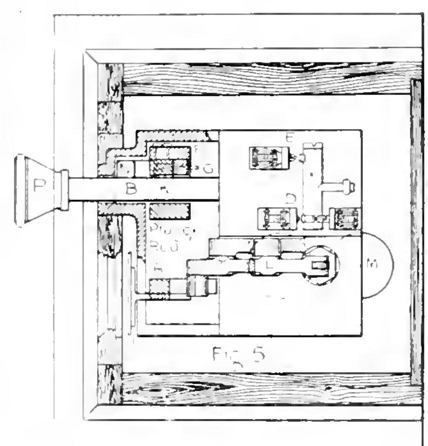
Of the three systems using this method of operation, that known as the Sykes system will be the first considered, not



only as it was the first to be invented, but because it has come into more general use than either of the other two. This system may be said to consist of a machine having the necessary levers for operating the signals, of the Sykes lock instrument, and of an interlocking relay, the latter being used in connection with the track circuit to prevent an operator from again releasing a signal until the train for which the signal had been released has passed out of the block.

A machine having the two levers for operating the signals governing trains moving in opposite directions, and the corresponding lock instruments, is shown in Figs. 1 and 2. The principal parts of the instrument, the lock bolt, the lock bar, the lock rod and the plunger rod, are also shown in the figures, the levers being in the normal position with the signals at danger.

To explain the operation of the instrument, the operator, when he plunges, releases, by means of an electric circuit, the



lock rod of the instrument in the next station, allowing it to fall by its own weight and lift the lock bolt from the lock bar, releasing the lever and allowing the signal to be cleared. As the indicator is attached to the lock rod, the indication would be changed to show the word "free" as soon as the lock rod dropped, showing to the operator that the lever had been unlocked. Clearing the signal, forces the lock bar forward, which, by means of the inclined plane and roller, raises the lock rod to its normal position, where it is held until again released by the operator at the next station. Raising the lock rod, changes the indicator back to show the word "locked," although the lock bolt does not fall into the hole in the lock bar until the lever is returned to the normal position.

The construction of the instrument

whereby the lock rod is released and allowed to drop when the operator at the next station plunges, is shown in Fig. 3. The magnet M attracts the armature A, thereby raising it and slightly turning bal-

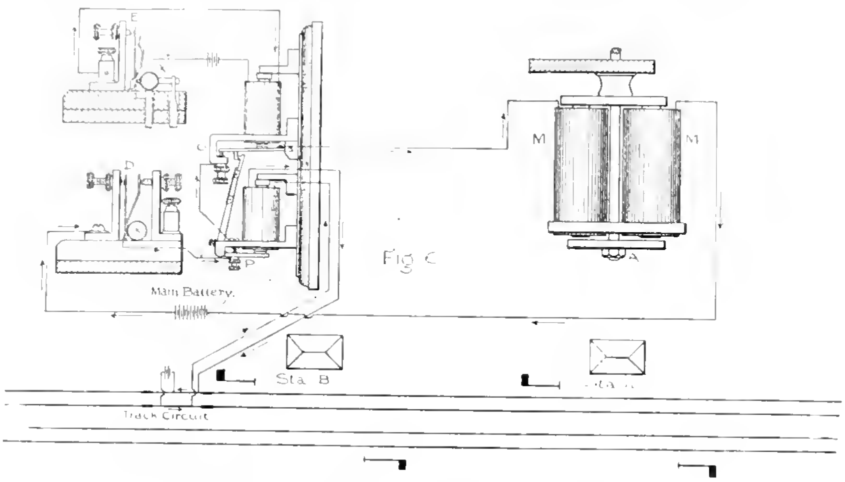


Fig. C

ance lever L on its center C; this releases trip T, which is then free to turn on its center, allowing the lock rod to drop by its own weight, unlocking the signal lever, as has already been explained.

Fig. 4 shows the construction of the instrument, whereby an electric circuit is completed when an operator plunges. Pressing in the plunger P raises the crossbar X, which, by means of the contact springs D and E, completes two circuits—one through contact D, Fig. 3, to the magnet of the next instrument, releasing the lock rod, and the other at E, Fig. 4, a circuit through the interlocking relay. This contact at E causes the relay to break the circuit just completed through the magnet

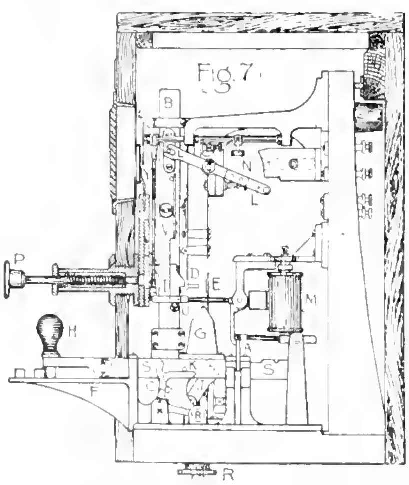


Fig. 7.

of the instrument at the next station, making it impossible to again complete the circuit at D by plunging until the armature of the relay has been restored to its original position by a train passing over and off of the track circuit.

The plunger when released is forced out of its original position by the action of the spring S, a dash pot Q being provided to retard this action, so that the electric contacts made at D and E will not be of too short a period of time.

The arrangement by which an operator is mechanically prevented from again plunging until the signal has been cleared and returned to danger, is also shown in Fig. 4. A trip rod F is provided, having attached to its side a pawl piece G and sliding block B, and carrying on its upper end a plate I, on which are painted the words "blocked" and "clear." Attached to the plunger rod (not shown in the cut) is a pin K, which, by means of the pawl piece G, supports the trip rod in the position shown in the cut.

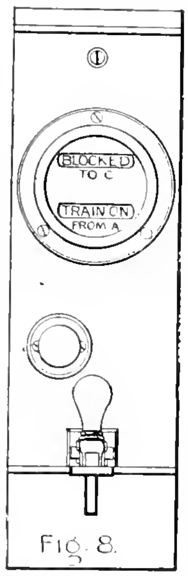


Fig. 8.

The plunger is provided with a side piece N on the side next the trip rod, so that when the plunger is pressed in, this side piece will strike the pawl piece G, pushing it off the pin K and allowing the trip rod to drop, the sliding block B striking on the top of the side piece N, which is then underneath it. When the trip rod falls, and with it the indicator, it brings the word "blocked" in front of the opening in the case, indicating to the operator that he has admitted a train to the block, and cannot plunge again until the train has

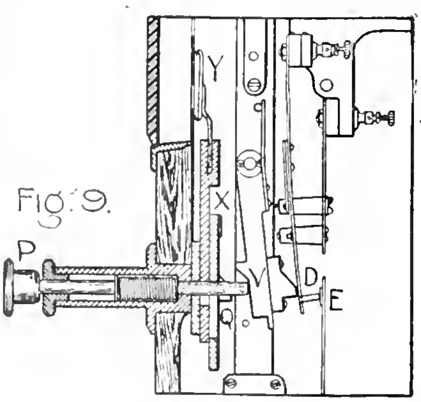


Fig. 9.

passed the station and the instrument has been restored to its normal position. On releasing the plunger, the sliding block B drops still further on the projection of the side piece N, and mechanically prevents the plunger from again being pressed in.

The instrument is restored to its normal position by pulling the signal to clear, which the operator will do as soon as the train which had been admitted to the block by his plunging, approaches the station. Clearing the signal, draws the plunger rod to the bottom of its stroke (Fig. 2), catching the pin K (Fig. 4) under the pawl piece G, so that when the signal is returned to the danger position after the passage of the train, the plunger rod is raised with it and the plunger unlocked. When the trip rod is raised, the sliding block B is raised with it out of the way of the side piece N, being held in the same relative position by the pressure of the pawl piece G. The raising of the trip rod changes the indicator to again show "clear," indicating to the operator that it is possible for him to plunge once more.

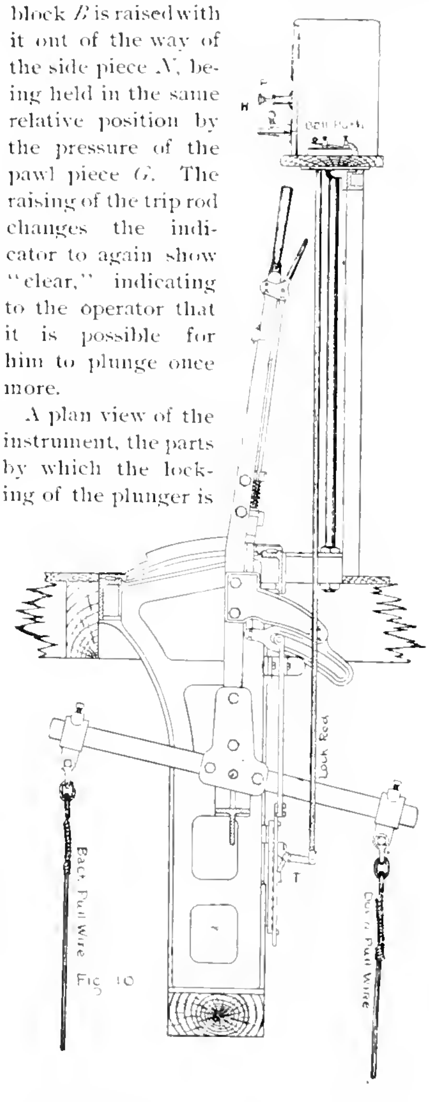


Fig. 10

A plan view of the instrument, the parts by which the locking of the plunger is accomplished being shown in section, is shown in Fig. 5.

To explain how the locking circuit is broken and restored through the combined action of the plunger, the interlocking relay and the track circuit, reference must be had to Fig. 6, in which all the parts made use of in this operation are shown. The relay and track circuit shown are those belonging to station B at the end of the block, the releasing magnet being the one belonging to the instrument of station A at the entrance of the block. Separate views of the contact points D and E are shown to make it easier to follow the action

that takes place when the plunger is pressed in and the crossbar X raised.

The construction of the bar X is such that the contact at D is made on the up stroke and that at E is made on the down stroke, the projecting point that engages with the spring E being arranged to turn

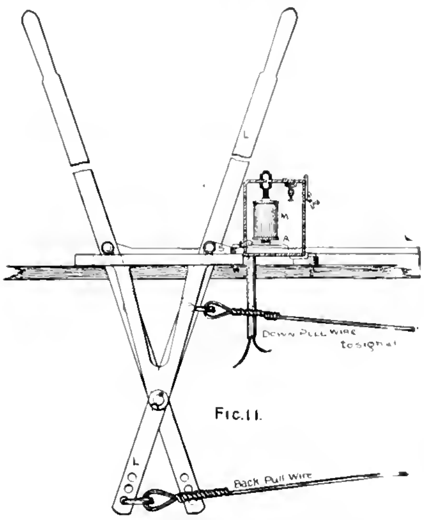


FIG. 11.

on the bar as a center and press against the spring only on the down stroke of the bar. The relay points being shown in the normal position, it is seen that the lower magnet is energized by the current which passes through the two rails forming part of the track circuit, and the armature is held up. The circuit of the upper magnet being broken at E, its armature is down and makes a contact at O.

When the plunger is pressed in and the crossbar raised, a contact is made between the points at D, completing the electric circuit through the main battery, the magnet M and the points O and P, energizing the releasing magnet M, and unlocking the signal lever at station A. On the crossbar X being forced down by the action of the spring S (Fig. 4), contact is made, as already explained, at the point E, momentarily completing the circuit, energizing the upper magnet, and thereby raising the armature and breaking the releasing circuit at O. On the circuit being broken at E, the armature falls, but now strikes on the hook on the upper end of the armature belonging to the lower magnet, and is held up instead of making a contact at O, and it is impossible to complete the releasing circuit as long as it is in this position.

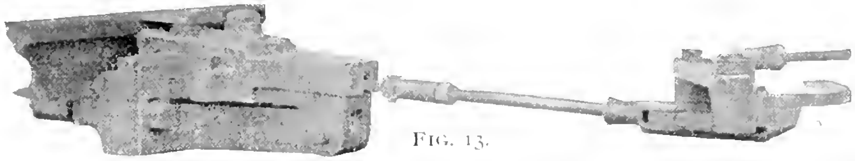


FIG. 13.

On a train passing out of the block and on the track circuit, the current passes from one rail through the wheels of the train to the other rail, and the lower magnet of the relay is demagnetized and the armature drops, breaking the releasing circuit at P, and letting the armature of the upper relay fall, again making a contact at O. When the train passes off the track circuit, the current again flows through the lower magnet, energizing it and raising the armature, making a contact at P and restoring the relay to its normal position.

From this it is seen that the interlocking relay in connection with a track circuit, makes it impossible for an operator to plunge and again release the instrument at the next station, until the train for which he had previously plunged had passed on and entirely off the track circuit, and therefore out of the block.

To prevent an operator from leaving his signal in the clear position, and not returning it to danger after the passage of a train, as he should do, an instrument has been designed called an "electric slot," which automatically sets the signal at danger and compels the operator to return the lever to the normal position before he can again gain the control of the signal. On his restoring the lever to the normal position, it is, of course, locked until released by the operator at the next station, and thus the purpose for which the slot was designed

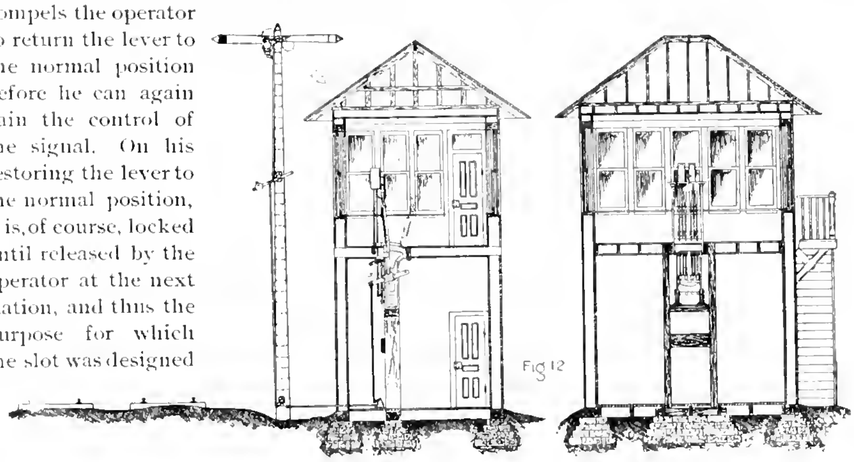


FIG. 12

is accomplished. The action of the electric slot is obtained through the use of an electro-magnet, energized by a current from a battery passing through the two rails of an insulated section of track. The armature of this magnet acts as a latch, and makes the connection between the signal and the lever whenever the magnet is energized. When the armature falls, as it will do when the magnet is short-circuited by a pair of wheels on the insulated section of track, the connection between the lever and signal is broken, and the latter goes to danger by the force of gravity.

The Sykes system is in use on the New York Central & Hudson River R.R., between Poughkeepsie and Buffalo; on the New York, Lake Erie & Western, between Jersey City and Turner's, and on a portion of the New York, New Haven & Hartford R.R.

In the practical working of the Sykes instrument, several defects were discovered, which, in the endeavor to perfect the system, resulted in a set of requirements being drawn up by Mr. C. H. Platt, of the N. Y. C. & H. R. R.R., which a properly designed controlled manual system should fulfill. These requirements were met in the machine designed by Mr. Patenall, electrician of the Johnson R.R. Signal Co., and which is now known as Patenall's block signal instrument.

The requirements of the new machine, and the objections to the Sykes instrument which it was designed to overcome, are:

First—That gravity must be overcome by the action of the electric current in unlocking the signal levers, instead of allowing it to assist, as it now does, in withdrawing the lock rod from the locked position. This means nothing more than that a failure of the apparatus should lock the signal lever at danger, and not unlock it, as now happens with the Sykes lock, if the latch holding the lock rod in place should slip or be jarred loose and unlock the lever, allowing the operator to clear the signal whether the block was occupied or not.

Second—That the magnets for unlocking the signal levers must not be in the electric circuit except at the moment of actual use, to prevent an accidental release by the crossing of wires, lightning or other causes. This requires an intentional setting of the instrument before it can be plunged to and released by the next succeeding station.

Third—That no interlocking relay must be used, the contacts all to be made in the instrument, where it is impossible for them to be tampered with or changed.

Fourth—That the signal levers be perfectly free after having been once unlocked, so that the operator can change the indication of the signal as often as he desires, and not to have the lever locked whenever the signal is returned to the danger position, as is the case with the Sykes.

The construction of the instrument is shown in Fig. 7, in which P is the plunger and D and E the contact points by which the releasing circuit is completed, when the plunger is pressed in. M is the releasing magnet, which locks the sliding bar S whenever the latch A is dropped into either of the two notches cut in the bar S. This sliding bar, when it is drawn out by the hand latch H to its full extent, engages,

by means of the pin *K*, with the rocker *C*, lifting the lock rod *R* and unlocking the signal lever by freeing the locking bar or tappet *T*, as is shown in dotted lines in Fig. 10.

This sliding bar *S*, by means of a second crank *J* (shown in dotted lines in Fig. 7), lowers, when pulled out, the vertical bar *B*, which, in turn, moves the lever *L*, bringing the inner end into contact with the plate *N*. This inner end is made in the form of a jaw and presses on both sides of the plate *N*, making a metallic connection between the plates fastened to each side. The plate *N* is made of insulating material having three metal strips, two on one side and one on the other, to which are attached the wires from the two circuits used in operating the instrument. The wire from the releasing magnet is attached to the one strip, the line wire from the instrument at the next station being attached to the lower and the wire from the track circuit to the upper strip on the other side. There are two indicators, one working in connection with the plunger *P* and showing the words "train on" whenever the operator has plunged; the other working in connection with the slide *S* by means of the lug *G*, the rod *I* and the indicator plate *O*, and showing the word "locked" or "free," according to the actual state of the signal lever.

The operation of the instrument may be explained as follows: Supposing a train to have entered block 1 and to be approaching station B. B asks C to release him, at the same time drawing out the hand latch *H* and pressing it down between the two lugs on the bracket *F*, so as to hold it in that position. This pulls out the slide *S* and raises the inner end of the lever L, so that a metallic connection is made between the strip on one side of the plate *N* and the lower strip on the other, putting the releasing magnet in the circuit with the line wire and the instrument at the next station.

When C plunges, a contact is made between the points of his instrument at *D E*, as is shown in Fig. 9, sending a current of electricity through the magnet *M*, raising the armature and with it the latch *A*, unlocking the slide *S*, which B now draws out, raising the lock rod *R* and unlocking the signal lever, as is shown in dotted lines in Fig. 10.

When the plunger is pressed in, the pawl *V* is forced off from the lug *Q* and the slide *X* drops, carrying with it the indicator *Y*. On releasing the plunger, the slide drops still further, making it impossible to again plunge until the slide has been raised to its former position. The words "train on" are now brought in front of the opening in the case, indicating to the operator that the track is blocked.

When the slide *S* was pulled out to its extreme position, the bar *B* was lowered still further, thus raising the inner end of the lever *L*, breaking the connection with the line wire, and connecting the magnet *M* with the track circuit relay. The breaking of the circuit demagnetized the magnet *M* and the armature falls, dropping the latch *A* into the slot in the slide *S*, locking it in this position until it is again raised by the magnet *M*.

When the slide *S* is pulled out, the lug *G* engages with the roller *U*, raising the rod and changing the indicator *O* to show "free," as the lever is now unlocked.

When the train passes out of the block and over the track circuit, it demagnetizes the track circuit relay, the armature of which falls and completes a circuit through the magnet *M*, raising the latch and allowing the operator to shove in the slide *S*. This lowers the lock rod *R*, locking the signal lever at *T*, Fig. 10, breaks the connection at the plate *N*, raises the bar *B* and with it the slide *X*, unlocking the plunger and making it possible for the operator to plunge once again. The indicators are changed back to their normal position, showing to the operator that the machine is locked and that no train is in the block. An electric slot on the signal pole is provided, which restores the signal to danger on the passage of a train, to make it impossible for the operator to hold the signal in the "all clear" position, and admit a second train to the block.

This system is in use on the N. Y. C. & H. R. R. R., between New York and Poughkeepsie; on the N. Y., N. H. & H. R. R.R., between New Haven and Providence, and on the Long Island R.R.

The equipment on the N. Y. C. & H. R. R.R., through the tunnels in New York city, is, perhaps, the most complete of its kind in the world, and one that, considering the business that is handled, can hardly be equaled in the amount of protection afforded by any other system.

As has been previously stated, neither of these systems—the Sykes nor the Patenall—are applicable to single-track roads, from the fact that a train on passing over the releasing section would release the instruments at the station in front as well as in the rear, and thus make it possible to admit a train to the block and bring about a head-end collision.

A controlled manual system that is applicable to single as well as double-track roads, and one that has been in service for about two years and has given good results, has just been patented by Messrs. Fry & Basford. As it is of low cost, thus bringing it within the reach of many roads not able to afford the more costly apparatus of either of the other two systems, I think that a short description of this system would be advisable.

The apparatus made use of may be briefly stated to be: an electro-magnet for controlling the signal lever; a polarized relay and pole-changing switch to energize the electro-magnet at the next station and unlock the signal lever; a track circuit, and a track instrument with the necessary relays to restore the releasing circuit when a train passes out of the block; an electric slot for putting the signal at danger immediately a train has passed by the signal.

As the drawing showing the several relays and the different circuits is somewhat difficult to read, I will not give it here, but will say that the apparatus is inclosed in a neat box with the handles of the two switches that are worked by the operator projecting from one side.

But one wire is used in this system, the telegraph instruments being cut out whenever it is desired to unlock the signal. The line wire is also grounded whenever the signal lever is pulled over and the signal cleared, so that the operator is cut off from communicating with the next station and is forced to keep the lever in the normal position as much of the time as possible.

The lock for controlling the signal lever is shown in Fig. 11, it being made to work with the ordinary levers used in operating the signals by the telegraphic method. *L* is the signal lever; *S* a sliding bar, with notches cut in it as shown and attached to the lever *L*; *A* is the armature of the magnet *M*, the end being made to fit in the notches cut in the bar *S*, to prevent the lever from being pulled over unless the armature is raised; *M* is the magnet for raising the armature and releasing the lever when the proper connections are made and the electric circuit completed between the two stations.

The operation of this system is as follows: Supposing a train to be approaching station A, and that A has asked B to release his signal, the block being clear, B shifts his pole-changing switch and reverses the current sent out from his battery to the main line. At the same time, A shifts his switch connecting the polarized relay with the main line, thus closing a local circuit through the releasing magnet *M* and unlocking the signal lever. Pulling the signal lever to "clear," breaks the main-line circuit, dropping the armature of a magnet in the instrument and making it impossible for the signal to be released a second time should the operator at B leave his pole-changing switch in the reversed position. On shifting the pole-changing switch back to its normal position, the circuit is broken between the battery and the ground, and positively held open until the train which has entered the block at A clears the track circuit and, consequently, the block at B. In this way the admission of a second train at A is prevented while the block is occupied. To prevent a train on passing out of the block from restoring the circuit to stations on either side, and make it possible to unlock the lever at the next station ahead, as well as the station in the rear, two circuits are made use of, by which, unless they are passed over and completed in a certain succession, the releasing circuit is not restored and, in consequence, it is impossible to clear the signal. One of these circuits is completed by the track instrument, the

other by a track circuit which is placed on the station siding, as well as on the main line, so that a train pulling into the siding would restore the circuits the same as if it had passed out of the block on the main line. The two circuits completed by this means are so arranged that the circuit made by the track instrument works a relay which closes the circuit completed by the track instrument, so that unless a train passes over the track instrument before it passes over the track circuit, no action is produced on the relay of the second circuit, and the releasing circuit to the next station is not restored. From this it is seen that the system affords the same protection to trains on a single track that is given by the other systems, which are applicable only to double-track roads.

Where roads have been equipped with a controlled manual system, the matter of expense has not cut such a figure as with the more simple apparatus, and the equipment has usually been more complete and all that good practice would require. As a rule, the instruments are placed in station buildings, but where these are too far apart, special cabins or towers are erected for the purpose.

If placed at a station, it is usual to put the signals for each track on the right-hand side, and at such a distance beyond the station as will allow the trains to stop at the platform without having to pass the signal. Where there is no station and a tower is used, it is usual to put the two blades on a pole placed immediately in front of it, as shown in Fig. 12, as the connections are shorter and the cost is less. If there are several tracks to be governed and there is no room to put the pole next the track which the signal controls, it is necessary to make use of a bracket pole having separate masts for each track, or else a bridge may be erected spanning all the tracks, the signal being put immediately over the track which it controls. The use of distant signals is, of course, optional, but the general practice is to put them in wherever the view is obscured, or the conditions such that the signal cannot be seen until the train is quite near it.

With a controlled manual system, it is possible to lock electrically all the switches and the levers of any interlocked crossing machine that may be in the block, so that when a clear signal is given it not only means that this block is clear, but that all the switches are set for the main line, and the derails and signals of any interlocked crossing are set for the train to proceed. This locking electrically is performed by fixing an electro-magnet on each switch and lever, so that it is impossible to open them unless the magnet is energized. This is done from the tower where the block signal machine is placed, and is so arranged that when the electric switch is set to release a switch in the block, the releasing circuit between the two stations is broken, and the operator at one station cannot plunge and release the signal at the next station.

The automatic torpedo signal—an auxiliary signal that works in connection with the home signal—has of late come very much into use with the controlled manual systems. The machine is bolted to the rails, and is so arranged that when the semaphore signal is put in the danger position, a torpedo is moved forward from the magazine and placed where it will be exploded by the first wheel that passes over it. When the signal is cleared the torpedo is withdrawn from the rail and a train passes by without exploding it.

It is thus seen that such an instrument is of great value in such places as a tunnel, or where the signal lights are apt to be obscured by smoke, or are in any way difficult to see, as it furnishes an audible signal about which there can be no mistake, and one which compels the engineer's attention. If exploded, it furnishes incontrovertible evidence that the engineer did not obey the signal but ran by it.

With the controlled manual systems, it is, of course, impossible to use permissive blocking, as such use does away entirely with the protection afforded by the automatic features of the system. For, if two trains are admitted to the block, the first one passing out would release the signal at the entrance of the block, and allow a careless operator to admit a third train before the second train had cleared the block.

This is undoubtedly a great objection to such a system, and one that will stand very much in the way of its general adoption by a great many roads. Its field of usefulness is thus limited to sections of roads, or divisions, where, on account of the difficulties of operation, or the number of trains run, it is not safe to make use of permissive blocking.

Cost of Maintaining Automatic Block Signals.

Few people have any idea of the cost of maintaining automatic signals of any kind. The cost of manual signals is large because the salary list is naturally large, but automatic signals must be cared for, kept in repair, batteries charged, etc.

Last year the Hall automatic signals on the Illinois Central out of Chicago (128 signals in use), cost $7.96 per signal per month for maintenance; two-thirds of this went for wages and one-third for material, and it is only fair to say that some of this was caused by changing tracks—a track circuit being used. This is very low, considering the many thousands of operations the signals made.

The Chicago & Northwestern have 154 Hall automatic signals out of Chicago, but use a wire circuit. Theirs cost $8.50 per signal per month, with about the same proportion for salary and material as the Illinois Central.

Keeping Boilers Clean.

We know of no subject connected with locomotive operating which has so much vitality and persistence as "How to prevent the heating surface from sustaining injury through the action of impurities in the feed water." This abnormally live subject was up for investigation and discussion by the Southern Railway Club lately, and the conclusions arrived at were summed up in the remarks made by Mr. R. P. C. Sanderson, of the Norfolk & Western, who said:

"The trouble from scale has been so serious with us that we have for some time tried to get rid of it by the use of any nostrum that had a chance of being a success. All of them proved failures. We also experimented with oilers. In stationary boilers, where the pressure is low, not over 60 or 80 pounds, we have had a measure of success; but when applied to locomotives carrying 140 pounds, or the like, of steam, they proved a failure. I do not believe that any compound can be used in a boiler that will prevent the scale formation, where different kinds of water are used—any more than any one panacea will cure various diseases. The proper place to treat the waters, if they have to be treated, is at the water stations. By getting the views of a chemist in regard to water, after analysis, something might be done to remedy the trouble. To attempt to combine different waters in a locomotive boiler, working under high pressure, and then give physic to cure the trouble, is a great mistake. Nothing but plenty of washing out will do much good. The Pan Handle people have had much trouble with Ohio waters, and I am informed, by good authority, that Dr. Dudley, of the Pennsylvania Railroad, after making several investigations, had nothing better to recommend than more frequent washing out. That has been followed with a measure of success."

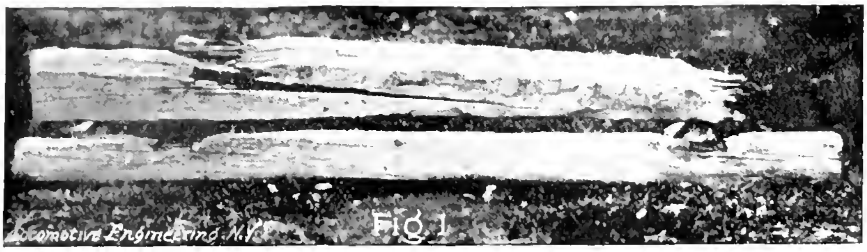
We wish to emphasize the views expressed by Mr. Sanderson concerning the importance of washing out the boilers properly. If invention and enterprise had been devoted as much to improving methods and appliances for washing out boilers thoroughly, as they have been to the devising of doctoring nostrums and mechanical scale preventatives, there would be less trouble from leaky sheets and flues. Washing-out appliances are, as a rule, of the crudest kind; there has been little improvement in them since the boiler was a small simple vessel that could be scoured with jets of water directed from a few points.

With the immense quantity of water evaporated in the modern locomotive boiler, there ought to be provided means of washing out every corner and surface where mud can settle. The greater part of the impurities which form into scale could be washed out if the work was properly done.

Timber Cross Sleepers as Track Gages.

BY JOSEPH ANTHONY.

Except as to gravel ballast, or other means of good drainage, most American railroads have, in their construction, all the elements that are needed to insure the



rail's necessary vertical and lateral planes. That the rail's plane is not as perfect as it might and should be, is due to the faulty combinations that are made of the connected members. A marked instance of this is in using those agencies, the sleepers, that support the rail in its vertical plane to maintain it in a lateral one also. Using

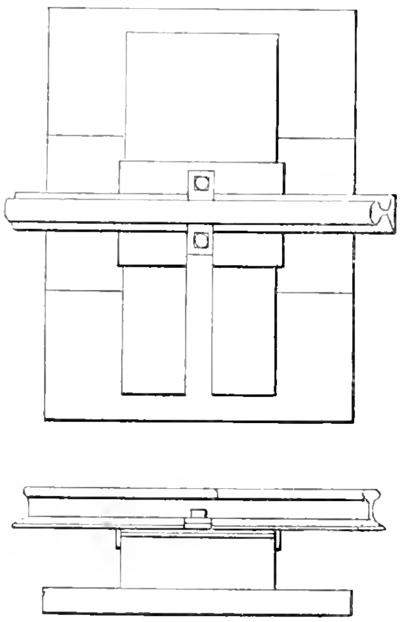
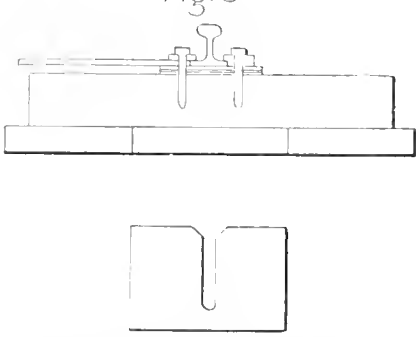


Fig. 3



STREET RAILROAD RAIL JOINT SUPPORT.

any soft yet durable wood for this last purpose soon destroys it for that of the first.

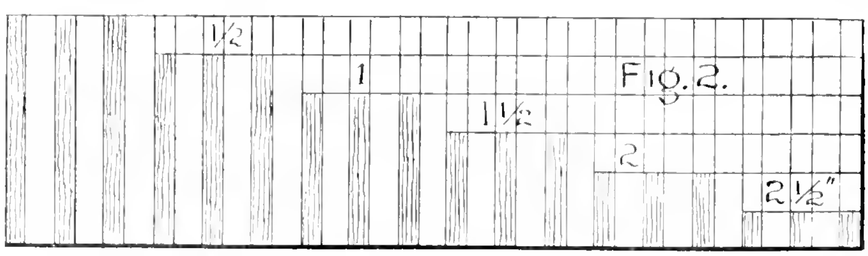
A sleeper is something that sleeps, something that lies dormant or still, and though, while supporting the rails under a moving train, sleepers may lie quite other than as still as they should, the fault is not their own; their failure to lie still is due to their form, their position, and to the rails being fastened to them. As ties, as gages, however, wooden cross sleepers are extremely faulty. Their defect is, that by loss of their gaging power alone, there goes with it what remains of their original vertical sustaining power, and their aligning stability as well.

Except in quickly decaying woods, the mechanical action of the rail's foot, assisted as it is by moisture and by grit under it, and by the spikes each side of it, destroys the sleeper as a tie, while its other portions and properties yet remain intact.

The supports that a rail, in use, calls for are three: first, they need to be supported vertically; second, they need to be tied, gaged, the proper distance from each other; and third, they need to be duly anchored or aligned. Each of these functions should be performed by a structure and a material which is best fitted for that duty alone. As cross sleepers are used, this triple duty devolves on each one of them, and if each function, like the parts of the Deacon's one-horse shay, were equally lasting, no mechanical incongruity would exist in the use of timber rail supports vertically, sills or sleepers, and horizontally, gages and anchors, also. This not being the case, a modification of parts is needed.

The accompanying Fig. 1, from a photo, shows the average condition of wooden sleepers, as gages, as last used and taken from under the rails. Such as these, while otherwise good, have no further tying or gaging worth.

This figure shows that, except for causes that have ruined them for further gaging use, both sleepers are, or would be, of original integrity to keep the rails in their due vertical plane. In all the multitude



of sleepers that are thrown out for causes other than chemical decay, there is yet in them their original area of ballast-bearing surface, to keep the rails from sinking, and there is also the same bottom and side frictional resistance, through the ballast endwise, to do the necessary aligning.

There are, under a rail's length of 30 feet, from 15 to 20 sleepers; a fair average may be said to be 18. If of durable timber, lasting, say, 10 years, and costing 50 cents, their renewal involves an annual outlay of 5 cents each. While more quickly decaying woods may be cheaper at first, their

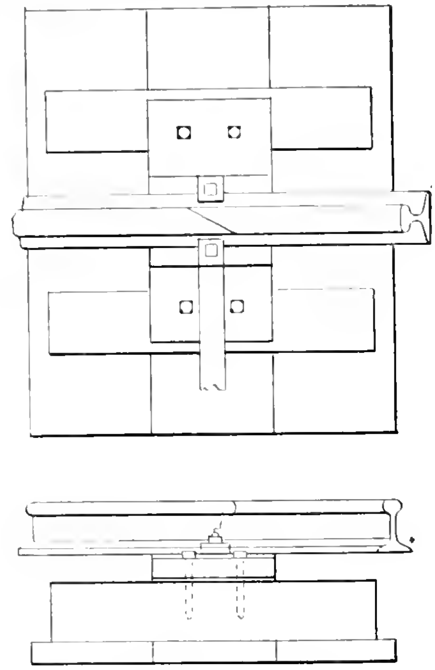
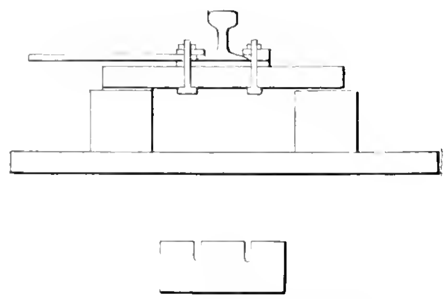


Fig 4.



RAILROAD RAIL JOINT SUPPORT.

annual cost will still be at about the same figure. Saved from mechanical injury, may not cedar, redwood, or other wood chemically treated, be made to last from one to five years longer than now? The question, then, which is involved, hinges on the mechanical injury that sleepers sustain while being used as ties, gages, rather than as vertical supports only.

The following diagram, Fig. 2, illustrates what is depended on for the maintenance of gage in rails as they are spiked on wooden cross sleepers.

In this figure are represented 18 sleepers, and on the supposition that their quality is

such that they last six years, three of them must be taken out as worthless each year. Those shown at the left of the figure, as also indicated by Fig. 1, have lost their tying power, and, for future gaging or aligning the rails, are wholly worthless. The next three, to the right, have yet a combined strength of one-half a sleeper. The next three, again, have a strength of 1 only, and the next three have a virtue equal to 1½; another three have a worth of 2 sleepers, and the remaining ones are as good as only 2½ more. Thus, at the opening of each sleeper-renewing season, while there are 18 forms of ties, gages, under a rail's length and on which reliance is placed to keep the rails from spreading, there are, in fact, means equal only to 7½ whole sleepers available for this important purpose.

Safety and economy in the gaging and aligning of rails demand a more enduring material than wood, and nothing less strong and less indestructible than iron or steel is fitted for such uses. The wear of such metal ties will be as nothing, and the question of their renewal need not be considered; once in place, they will last a lifetime. With iron gaged rails, their vertical supports only need to be looked after, and pine or other soft and cheap woods, chemically preserved, or cedar suitably tie-plated, may well take the place of oak or other dear material. Relegating each of the three duties that the common cross sleeper has to perform, to a separate and a suitable device, such a material and such a form for each of them may be found and adopted as will not necessitate throwing away material that may be sound and capable of supplying remaining needs.

A better mechanism asks that rails be supported vertically by individual broad-based sleepers under each, and duly protected from wear; that the rails be gaged by iron bars, duly fastened to each rail's foot; that there be sills, anchor sleepers, bedded longitudinally with the rails, between the vertical supports, and to which the gage bars, where they cross them, should be securely bolted. Thus each part will not in any way impair another part, and each may be repaired or renewed without disturbing the others; and what is most important is, that each disturbing force may be met with the full and equal resistance that is needed to neutralize it and to leave the parts intact.

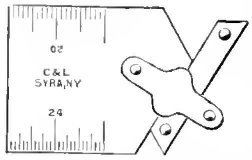
In Figs. 3 and 4 are suggestions of forms that go far to meeting these requirements. Angle-bar splices go with these, and while they are specially designed for supporting the rails at joints, the same, or modified forms of less area, perhaps, and proportionately spaced, is fitting along the other parts of the rail as well.

Such a way may be a permanent one in fact, as it is now only in name, and the excuse for occurring wrecks, that "the rails spread," may no longer voice a mechanical shame of the railway's mechanism.

A New Center Gage.

We illustrate herewith an improved form of center gage that ought to be appreciated in railroad shops.

The ordinary center gage is good enough for lathe centers and such work, but for thread tools, where it is most used, it is defective, in that its shape will not admit of testing the ordinary run of inside thread tools.



The gage shown herewith will go over the point of any thread tool for inside work, no matter how heavy and clumsy the shank may be.

The angle is formed by a piece separate from the body and is adjustable back and forth. The points of this adjustable piece are the right angle to go down into the threads of a screw, while a 60° notch can be formed with sides of any unequal length.

One of the most important improvements lies in the fact that the angles are formed by outside grinding. There are no notches to grind into, and the gage can be trued, or made in the first place cheaper than the old form.

It is manufactured by Coffin & Leighton, of Syracuse, N. Y.

An Improved Claw Bar.

Mr. J. W. Gray, foreman of the West Shore roundhouse at Kingston, N. Y., has recently patented a claw bar that has been used with success for some time on that road and several others.

The improvement consists of a head in which the bar works, said head forming a hook to help hold the spike to be withdrawn; the fulcrum of the bar is formed in the head and the movement of the lever causes the spike to be lifted up straight, doing no damage to the tie or the spike.

This device takes hold of the spike sidewise and can, therefore, be used between

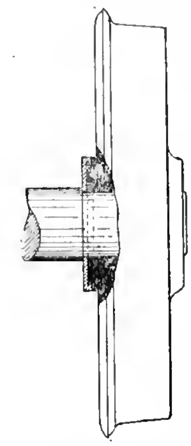
guard rails, around frogs, in road crossings and other places where an ordinary bar cannot be used at all. For yard work this bar has proven itself a great improvement over the old form. It will pull anything with a head to it.

The air-brake men meet in St. Louis, April 9th.

Taking Up Lost Motion of Engine-Truck Hubs.

Among the many methods of taking up lateral motion, due to wear between box and hub of wheel on engine-truck wheels, the one used by the Great Northern Railway commends itself in many particulars.

General Foreman George Dickson is the father of the scheme illustrated, after having given a trial to many of the stereotyped fads commonly resorted to for keeping wear within the prescribed limits.



When the lateral motion becomes excessive between box and wheel, the latter is pulled from the axle and placed in the lathe, where the hub is faced up true, and such an amount taken off as will allow a plate of proper thickness, say ⅜ inch, to be applied, thus restoring the original relations.

Up to this point there is a striking similarity with proeesses used in other shops, but the likeness ends here. While the wheel is in the lathe, a shoulder is formed on the outer edge of hub, and the diameter at bottom of shoulder is slightly less than at the outer face of hub, leaving what looks in section like a dovetail. The plate is then faced and bored to correct dimensions, allowance being made for a shrink fit on shoulder, after which it is warmed and applied, and the wheel pressed on.

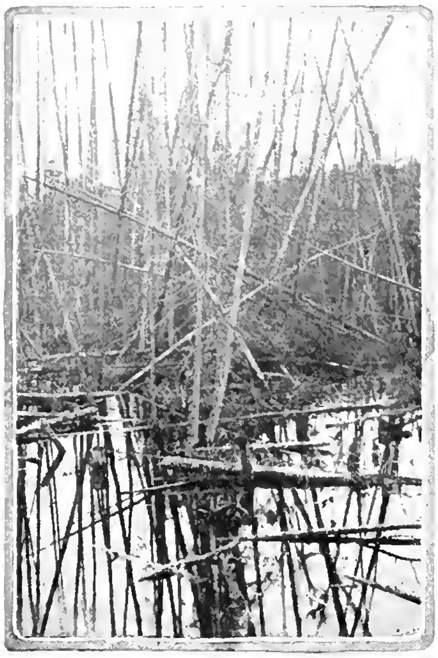
The Fall Brook Railroad is 250 miles long and handles the heaviest tonnage, for the same number of miles, of any single-track road in America. Last year it carried 488,000 passengers—it has never killed a passenger—and injured two of them; these were both drunk at the time. It ran 21,167 trains of freight, containing 670,000 cars, mostly coal laden. Three employés were killed and 47 injured. This is the road where there is no lay-off for punishment—results seem to prove the rule a good one.

Stating that a feed-water heater for stationary engines was of so much horse power meant nothing very definite—all depending on how much water goes through the heater and how much it is heated—and all this depends on what the engine uses. Several manufacturers of heaters recently met in this city, and agreed to abandon the use of the term "horse power," and state instead the square feet of heating surface contained in their heaters. This is sense.

We are out of Chart No. 1, given in 1894. Don't ask for it.

Building a Railroad Through a Swamp Country.

The Chicago, Milwaukee & St. Paul recently opened a new extension of their Wisconsin Valley Division, which presented some obstacles to construction not always found.



What the Surveyors Found.

The first engraving on this page shows the virgin swamp that the surveyors tackled. The line runs through swamps, sandy lowlands and among numerous lakes.

The second picture shows a "sink hole"—there were three of these within two miles. The material used for the fill was heavier than the mud in the bottom of the lake, and it kept sinking and raising the mud around it. There is an island of mud to the right of the fill.

On page 213 are two views of the line in the more substantial sand—one taken before the track was surfaced or aligned and the other when ready for business.

The Difference Was in the Rent.

Isaac Dripps, while M. M. at Bordentown, N. J., of the C. & A. Ry., many years ago, had one machinist, a notorious shirk, that put in more time in the water-closet than in the shop. He proposed to teach him an effective object lesson; so one pay day Sojer's pay was two-thirds less than what it should have been. Sojer went to Mr. Dripps, complaining. Dripps for a time seemed not to understand it; he then asked his name. "Oh, yes! Mr. Sojer! Now I recollect—that is all right! You see, the difference between what you think is due you and what you got is the *rent we charge* you for the water-closet!"

For the first six weeks of 1895 we received 11,339 paid subscriptions.

Jim Skeevers Has Some Object Lessons Not All of His Own Make—Shop Petitions—Painting Tools—Selected Scrap.

Jim Skeevers has his tool grinder; the boiler shop has the big grindstone; the blacksmith shop has only one fire on tool dressing; the men have the tools delivered to them; the lathes have more work to do—and the general master mechanic has a petition for Skeevers' removal as general foreman, signed by ninety-seven per cent. of the men employed.

The worst of it was that the petition was circulated and signed before Skeevers knew a word of it. This, of all things, on Skinny Skeevers, who had the reputation over the whole road for "getting on to things."

Skeevers dropped into the tool room for the tenth time to admire the new tool grinder in the hands of Hiram Eddy, one of the oldest and steadiest hands in the shop.

Hiram sawed wood steadily until the other man in the room went out for something, then turning to Skeevers, he said:

"Mr. Skeevers, I never got a chance to half thank you for picking out this nice easy job for me in my old age. I've run that big wheel lathe for twelve year, and was gettin' to notice the liftin'. It amounts to more to me than you think, and—well, seein' you've done something for me, I'd like to do something for you, and I reckon I can. When it comes to a show down on this petition you can count on Hiram Eddy, that's all, and damme if I don't——"

"What petition is that, Hiram?"

"Didn't ye know they'd all signed a paper to have ye discharged? The devil you didn't. Well, they have?"

"What for?"

"That's it; there ain't a darned one of 'em can tell. You bet they left me out, but they as't my boy Johnnie there, him as runs the radial drill, and he told me this noon."

"Who signed it?"

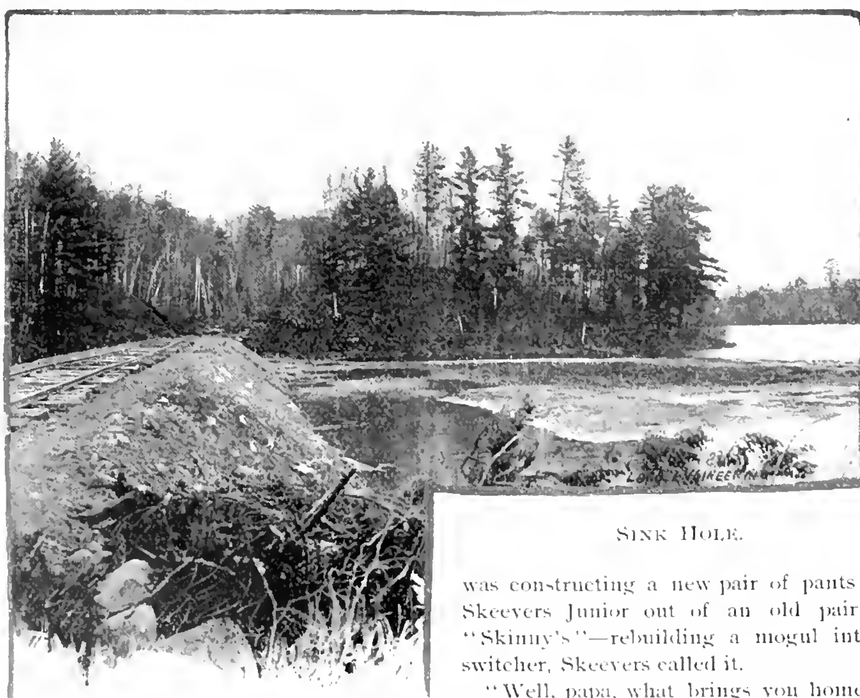
"All but eight; me and Johnnie's two, and I reckon you could name the other six—they are the best men in the shop. I told Johnnie you'd nip it in the bud; but, Mr. Skeevers, there ain't no bud—they took it to the old man last night."

"Say, Hiram, do me a favor and don't mention that you told me about —— "

"God love ye, man; I was goin' to ask ye the very same—one of my mottoes is to never go out gunnin' for trouble; but if trouble *comes to ye, why, make it red hot for that ere trouble!*"

"Much obliged, Hiram; I guess it won't amount to much. I tried to do the square thing here by the men and the company. It takes two to make a bargain; the men don't seem to want the square thing; if the company is of the same mind, why, I'll move."

Skeevers went back to his office soberly. He noticed some pantomime performances among the men that would have passed unnoticed ordinarily, and after fifteen minutes of thinking over the subject he mentally resolved to let the shops of the Great Air Line go to the devil, put on his coat and went home at 4:30—something unheard of since he took charge.

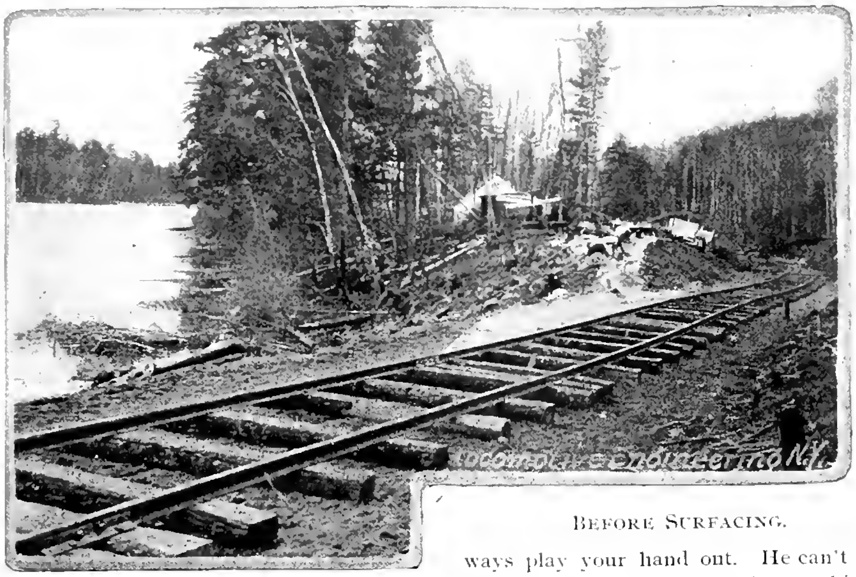


Sink Hole.

Sarah Skeevers put down her work; she was constructing a new pair of pants for Skeevers Junior out of an old pair of "Skinny's"—rebuilding a mogul into a switcher, Skeevers called it.

"Well, papa, what brings you home so nice and early?" Mrs. Skeevers always addressed her lord and master according to her mood and the impression she wished to convey to the soul of the man she loved best. Her salutation when she knew he was tired, ill or worried, or when the children were ill or wanted something she thought they deserved, was always "Papa"—she might as well have added,

"tell me, I want to help you; can't I do something?"—sympathy. It was "Pa" when all was well at home and away; "James" for sympathetic seriousness; and "James Skeevers," with square, sharp corners, when she wanted to be severe, to reprimand or impress. One glance at



BEFORE SURFACING.

Skeever's face, and her work went down and her lips said, "Well, papa," while those cool, gray, inquiring eyes said all the rest.

"Sairy," said Skeevers, forgetting everything else, "where's that letter I got from the general manager when we moved up here, saying I could have my engine and run back whenever I wanted it?"

"Sit down, sit down, crazy man, I'll get you the precious letter after supper—tell me what the matter is. Has John Massey been up to some of his sneaking tricks?"

"John Massey's all right; it's the darned swine that I got the wash room for, whose pay I got raised, whose shop I made comfortable, whose interests I looked after without a word from them or to them—they are the ones who do the 'sneaking' trick, not John Massey!"

"Tut, tut, papa, don't have another fit like that till you tell me what's wrong."

"Wrong! Why, Sairy, you couldn't guess in ten years—they've got a petition signed asking for my removal."

"What for?"

"That's what's got me, what for?"

"When did you first hear of it?"

"An hour ago."

"Well, it hasn't gone far, then."

"There's the hell of it, Sairy, that's what hurts worst; all but eight men signed it and took it to the old man before I heard of it."

"And he surprised you for once, did he?"

"No, he hasn't said a word; I got on to it outside."

"When did you see him?"

"Two o'clock."

"And he had the paper then?"

"He must have."

"Well, James, then you bet that John Massey is up to something—he was going to spring it on you."

"I'll fool him, Sairy; I'll go down in the morning and throw up the job and demand my run."

"No you won't; you'll just wait. Always play your hand out. He can't surprise you, and you always have a higher court—the one that appointed you receiver of the back shop. If it comes to that, go to the general manager."

"Not I. The general manager has always come to me. I'll—say, but wan't it devilish mean of them cattle, them swine, the dog-goned, low-down——?"

READY FOR BUSINESS.

"Tut, tut. Sheep, papa, sheep—don't blame them all, they are sheep, they follow the bell-wethers; just drive 'em into the pen again, salt 'em, sell the bell-wethers for mutton, and they will all be lambs again."

"Damn a sheep ranch, anyway; I'd rather have the "318" on one and seven than all the darned shops between here and Tophet, anyway."

"James Skeevers, you know I'm not one of those 'I-told-you-so' women, but you may recall that I warned you that something would drop; John Massey is insanely jealous of any man that knows as much as he does—*and shows it*—I'm afraid you've showed something. But you take my advice, go back to the shop in the morning and see what happens."

"I'll take that letter, don't you forget it; I'm not going to fry and sizzle on the gridiron for days; bet you a red apple I'll take one out day after to-morrow!"

"Not till you see the Grand Mogul."

"He's going East to-morrow night for a month—we fixed his car up to-day."

"Don't he always come to the shops before he goes off on one of his trips?"

"Yes, always."

"All right, pa, something will happen to-morrow."

The next morning Skeevers went to work as usual; his fit of disgust was over; he was the same shrewd, cool, keen Skeevers. He had had an object lesson, and learned something, as he told Sarah the last thing before he went to sleep, and that was that a man in his position must not pay too much attention to mere mechanical operations, but must look after his men, keep in touch with them; in fact, improve the human machines as he improved the iron ones. A successful manager of a shop knows more about handling men than about handling machines.

Skeevers made his usual round, looked over his shop orders and placed them, checked up his time card of work, took an extra run through the boiler shop and then went into the old man's office.

The three scratchy pens of the three clerks stopped scratching all at once—they expected something.

The G. M. M. was polite, but as cold as the soul of a money lender—but he said good morning civilly enough.

After answering a half dozen questions, the old man asked:

"What did you send Martin Tobin in here for?"

"His time."

"What for?"

"Wouldn't obey orders."

"What did he do? What orders did he disobey?"

"The order not to take tools to the blacksmith shop to be dressed, nor to grind tools himself."

"He says he was doing a special job that required a special tool."

"Johnson did it easily with the standard shape."

"The men seem to be quite dissatisfied. I don't like it a bit."

"What are they dissatisfied about? Their pay has been raised, the shop improved, and——"

"Well, they are dissatisfied with the boss. Mr. Skeevers, I could surprise you with the extent of this feeling. How many friends do you suppose you have in the machine shop?"

"Mr. Massey, you can't surprise me for a single second. You are referring to that petition you winked at, which was given you day before yesterday. It was signed by all but eight men in the machine shop. I don't care a damn for it. I could get a bigger one to *have you hung* if Martin Tobin, John Welsh and a few others signed it first. You could have saved yourself lots of trouble, Mr. Massey, by coming to me first. You seem to think I am in the way."

"Your resignation would not cause any tears around here, and the sooner I get it the better."

"Well, you won't get it. I've got a letter here from you signed by the general manager, that I can have my engine back—and I want her. As far as the shop job is concerned, Mr. Massey, you can take it and shove——"

"Hist! Hist!" said two clerks at once, "here comes the old man!"

The G. M. M. melted at once as the door opened. "All right, Skeevers, come in at 3 o'clock and we'll fix things up. Good morning, Mr. Wider."

Skeevers was mad again. He laid out the foundation, in his mind, for a plain talk to John Massey, went back to his office, picked up a few things of his own, and thought he'd take a final walk through the shop before dinner—for he knew that the leaders would know of the row in the office ten minutes after the officers left it. Some clerks love to peddle gossip of this kind.

The G. M. M. wanted to keep Skeevers and the general manager apart for that one day—he didn't intend to spring the petition until his superior was well on his way to the Far East—so he steered into the boiler shop first. In going from the boiler shop to the main shop, they went through the wing used as a bolt room.

"Great guns!" said the G. M. "What are all those stacks of bolts for?"

"What bolts are them, there?" asked the old man of Mike Daly, the "straw-boss" who ran the first machine.

"The bridge department, sorr!"

"Why, Massey, you told me you couldn't do all your own bolt cutting and asked for a new machine not three months ago—I sent track work out on account of it. How many bolts of your own are you cutting now?"

"I haven't the figures with me. I'll look it up."

Mike answered for him.

"The same as ivver, sorr. We used to be workin' overtoime to do it before that man Skeevers come; but he do be the roarin' divil for doin' things. First he makes them little pumps to kape squirtin' ile all the time and does away wid the squirt can entoirely; then up he hops the speed av the cutters, an' no more do we git used to that than up he hops it again. Wan av thim machines would be oidle now but for the bridge woork as he took away from Davis—and mad enough he is about it."

"Skeevers is a wheel horse, ain't he, John?" said the old man—but Massey was busy looking at a piece of iron.

When the general manager opened the door to the main shop, he stopped short and exclaimed:

"Holy Moses!"

Skeevers had every machine tool in the place painted white; they were clean, and the light fell in dark places heretofore unknown except to gloom.

The old man looked around admiringly. "It's a parlor, John, neat as a pin; now, if you'd a' asked me if you could paint them tools white, I'd a' said "No," and thought you was crazy to boot, but when it's done a fellow sees that its just the right thing. Bet you a hat the Midland will paint their tools white inside o' six months; everybody will. It's great."

"Here's Skeevers," he continued, as that worthy showed up at the side entrance and stopped to speak to a man on the axle lathe. "Skeevers, this here ghost show is great—I approve of it, in red ink—but, say, what are ye cutting that old axle in two for?"

"An object lesson."

"Good enough; it's like a conundrum, though. I give it up; where's the lesson?"

"It isn't ready yet, but I might say that this axle is one that broke under the 18's tender last week; a clean break, you see, but looks as if the iron was crystallized. I have cut half a dozen axles and seven or eight broken pistons in two and etched the surface with acids, to see if I could find out what made them break, or rather prove what breaks them. I know already, I think."

"Well, I expect it's bad material; these dam supply houses are getting worse and worse."

"But, Mr. Wider, this and all my samples are 'our own' best selected scrap material, and finished in our own forge shop."

"That's curious; nothing better than selected scrap, is there, John?"

John nodded assent.

"Of course, I know both of you won't like to hear this; but it's my opinion that all our trouble with broken axles, crank pins and pistons comes from the sole and simple reason that we make the material ourselves."

"The devil you do."

"I do, just the same. Now, you cannot, at this day, select small scrap carefully enough to prevent a little steel from getting into the material. Look at the end of this broken axle; see that bright spot there. Nothing under heaven but a piece of mild steel; it won't weld. When your fagot bar is at a welding heat, the steel (which melts at a lower temperature) has burned out—a wreck is the result."

"We count that we save money on our scrap, though."

"There's lots of difference between figures and results. Wrought scrap is worth about $9 a ton. If I was boss, I'd sell it at $4, if I could get no more, and buy new muck iron from the pig. Any good forgeman can make good axles of that."

"Yes, but we've made a feature of this, and I've sent blue prints of our furnaces and photographs of our scrap bins to my friends, and advised them to go into it as an economy. I don't see how a piece of steel is going to get in. Don't we have a blacksmith pick it all out?"

"Yes, he is *supposed* to pick it out. But he don't, and he can't. Then you should tell your friends to count the cost of breakdowns and repairs, and charge it up to 'our own selected scrap;' it's only fair."

"Let's go look at those specimens."

They visited Skeever's office, where the old man viewed the broken ends of "selected scrap" material, and nodded as Skeevers pointed out the apparently crystallized part where the fracture started.

"Then, Skeevers, you want us to give up making scrap axles, do you?"

"I don't care a cent, Mr. Wider; but that would be my advice if you asked it. All I want is some new iron or steel pistons and axles in engine "318," and I guess she's got 'em yet."

"Well, your old engine is a good one, Skeevers; but you can't take more interest in her than the rest."

"I can't run but one—unfortunately—and so I must confine myself to the "318."

"You've run your last engine here, my boy."

"But, sir, I've got a letter signed by you, saying I could have my engine back, if I didn't suit here, or——"

"Well, who the blankety blank says you don't suit."

"Mr. Massey asked for my resignation this morning; he's got it, and I'm—— "

"Mr. Wider," broke in Massey, "I received a petition signed by all the men under Mr. Skeevers, except eight, asking for his dismissal, and I—— "

"You be damned. Go, get them other eight names; then throw the measly thing into the turntable pit. Tell 'em, dam 'em, that the officers of this road are going to send them a *unanimous* petition that they expel their 'grand, worshipful, high-muck-a-muck;' to kick their preachers out of church; to get divorces from their wives—we'll petition *them* awhile; it's just as fair."

Skeevers picked up a piece of blue paper that had been laid on his desk in his absence, glanced at it, and said:

"Here's my time, anyway, signed by my superior officer, Mr. John Massey."

"John Massey be damned. You are going to be high-cock-a-lorum here for a month, while John goes down East to watch the new engines being built at Baldwin's. I forgot to tell ye, John; but you can go with me to-night. So skip home and get ready. Skeevers, if you want to take down those furnaces out there, and sell the scrap, do it. Do anything, buy anything—you have my authority to order anything you want—*provided*, Skeevers, and don't forget the provided part, you get it as cheap as you did the tool grinder!"

The old man turned round in the door with a twinkle in his eye, and asked:

"What would you take for Massey—in a trade? Scrap hose ain't worth much," he added, "but I'll tell ye, Skeevers, if ever you take your time from John Massey without coming to me, I'll couple you on to him, and make a runnin' switch of ye both up the graveyard branch, where the weeds are so high that ye can't see the telegraph poles?"

A Good Cause for Keeping Boilers Clean.

On a recent visit to the Chicago & Grand Trunk shops at Detroit, something Master Mechanic Roberts said about frequent boiler washing led us to remark that we did not know they were troubled with such bad water.

"Our water is fairly good," said he, "but coal is expensive—we wash out often on that account."

We wondered how many railroad men looked at the expense and trouble of boiler washing in that light—who voluntarily ordered frequent boiler washing where the engines could be run without it.

It has come to be pretty well understood now that half of the cracking, pitting, seaming and blistering can be avoided by painstaking care of the boilers—constant inspection and washing.

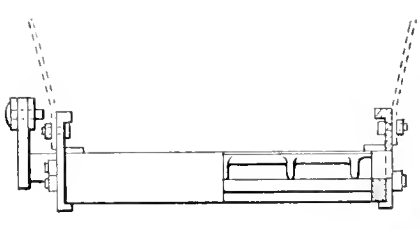
Few railroad men realize that a scale of even a sixty-fourth of an inch on fire sheets and tubes means decreased efficiency of evaporative effect.

The ordinary locomotive boiler evaporates an enormous quantity of water in a small space every day, and water ordinarily considered first-class will contain enough scale or mud-forming substance to seriously impair the steaming qualities of the boiler, if it does not lay the foundation of worse disorders.

More boiler washing and cleaning will be done in the future "because fuel is dear" than because the boiler foams, and when there is, we will have less boiler repairs, failures and expense.

What Makes an Unbalanced Wheel Revolve Steady at High Speed.

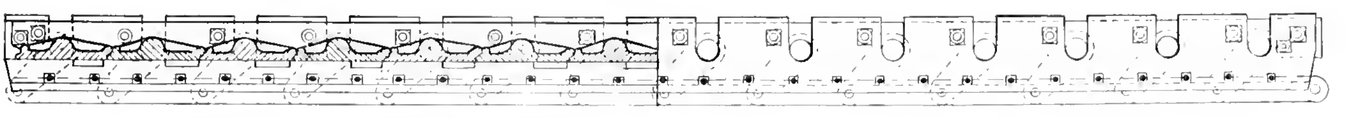
In a paper on "Counterbalancing of Driving Wheels," by Mr. R. P. C. Sanderson, read at the Southern Railway Club, a mechanical fallacy is exploded which for the past few years has led to no little theorizing and speculating among men given to playing with mechanical curiosities. In a paper read at an engineering society several years ago, there were some curious theories advanced about why an emery wheel out of balance, that would wobble at low speed would run steady at high speed. The explanation given was that the rapidly revolving wheel changed its axis of rotation, worked itself toward the center of gravity and found for itself a balanced center of rotation. Mathematicians demonstrated this theory to be correct.



As an aid in investigating the counterbalancing of driving wheels, Mr. Sanderson made an apparatus which could be revolved rapidly on centers that were free to move. Provision was made for making one side of the revolving disk heavier than the other. When it was run out of balance, it was found that the center of gravity had a decided tendency to fly away from the center of rotation. In other words, it did what learned college professors had, to their own satisfaction, proved it could not do. It is dangerous putting much faith in mere theories about mechanical actions. We are now ready for new theories of why a worn emery wheel runs steady at high speed.

He Knew the Cause.

An old engineer on one of the roads running into Weldon, N. C., was once waiting on time, which was short, and, consequently, his mill being full up with pitch pine was fairly fogging. A new dignitary—so new that to obtain any and all kinds of information he didn't hesitate to ask questions in a tone and manner that left no doubt as to his official importance—while making his way to the train, bumped against "Uncle Rufe," and after wiping the water from his eyes, finding out who it was who dared impede his progress, asked: "Mr. Blank, can you tell me what makes this engine smoke so infernally bad?" "Well, I don't know as I can make you understand it," said Uncle Rufe, "but if you'll git up there I'll try," and leading the way, he turned to his superior and asked: "Now, do you see that pile of wood? Well, my fireman takes that wood and puts it in [opens the fire door] this hole, and goldurnit, that's what makes the smoke."



A Dumping Ash Pan of Cast Iron.

On the Great Northern they use a dumping ash pan on the "Newth" or "window shutter" order that is better than any we have seen.

The difficulty with the old Newth pan was its flimsiness; a little heat would distort it so that it was not tight to begin with and could not be dumped.

Our engraving shows the bottom of the ash pan for one of their large consolidation engines; it is straight; the back axle goes through a large flue running across the pan.

The bottom of this pan is composed entirely of castings, without machine work of any kind on them. The slats lap together as shown, and make a tight joint. By loosening a couple of bolts, any slat may be removed without disturbing the rest.

The connections may be connected to either side, and half of the pan dumped at a time if it is thought necessary.

This is so much better than any sliding arrangement, and so easily operated and repaired that it commends itself at once.

An ounce of gum camphor dissolved in a quart of coal oil will make your headlight give a whiter light. Don't put it in the oil tank; it will gum the wick. Dissolve it first.

LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Breakage of Axles.

The past winter has been noted for the small volume of freight moved. When business is light we naturally expect that accidents to rolling stock will be rare, yet the past four months are conspicuous for the number of accidents that have happened through the breakage of axles. The tendency is to run the trains faster than they were formerly run; and every addition of air brakes to freight cars keeps increasing the inducement to accelerate speed. The increase of speed puts greater shocks upon axles when running over rough track, and so accidents due to broken axles will keep increasing, unless measures are taken to provide axles superior in strength to the average of those now in service. The muck-bar iron and scrap iron from which most car axles are made are not strong enough or reliable enough for modern service. The axles, besides being made of unsuitable material, are seldom subjected to the proper tests, which would demonstrate their weakness. They are taken on faith, and the parties supplying them are good naturedly excused from putting them through the drop test or any other searching form of examination. This good nature, which is bad business, is proving an expensive luxury to many railroad companies.

The ordinary run of muck-bar or scrap axle is too unreliable for modern service. The demand for cheapness leads to the supply of the poorest kind of an article, and expensive accidents are produced by a few dollars being saved in the first cost of axles. In a discussion that followed the reading of a paper on Steel Axles, by Mr. L. R. Pomeroy, at the New York Railroad Club, a number of practical railroad men admitted that the greater part of the axle breakages of late had been with those made of iron. Since that time we have obtained information concerning subsequent breakages of axles, and in nearly every case those that gave way were iron. The lesson of this ought to be apparent. The weak, unreliable material should be abandoned for a material which the best records prove to be more reliable than iron.

Makers of iron axles are not now in a position to compete with steel if the specifications are as rigid as they ought to be. A member of the New York Railroad Club, in the course of the discussion referred to, said: "I favored iron, and we were about to build a thousand cars, and, in conference with our general manager, we decided to insist on iron axles, and we put out a pretty strong specification; we were very anxious for the cars, as business was crowding us. We were unable to get any iron axle manufacturer that could fill the specifications. I spent more than half my time inspecting axles personally, and finally consented to let them build 500 with steel axles and 500 with iron. After those cars got on the road I was looking for broken axles right along on steel, and it was only a few days after the cars got on the road when we had a broken axle. I arrived at the conclusion that it must be a steel axle, but I found it was one of the iron axles. Since then we have had several axles broken under these cars, and they have been invariably iron axles."

One of the most extraordinary things known in the annals of engineering has been the antipathy which railroad men in America have displayed to the use of steel for purposes where strength and reliability were of the utmost importance, purposes for which steel was pre-eminently superior to any other metal. The experience of many generations gave us the saying, "true as steel," but the sentiments of many railroad men would pervert the saying into "false as steel." The prejudice against steel is slowly dying out, but we occasionally hear sentiments of antipathy expressed, and within the month a prominent railroad man, while condemning the inferior muck-bar and scrap iron axles, frankly made public the fact that he had no use for steel because it was treacherous. There are purposes for which good iron is superior to steel, but the manufacture of axles is not one of them.

There are some exceptions to the rule, but it will generally be found that iron axles remain longest in favor on roads where records are loosely kept, and where tests or rigid inspection are not considered of much practical value.

The men who talk about steel axles being treacherous have nothing to say against steel tires, and none of them would dream of specifying iron tires. Why does it come that the superiority of steel tires is unquestioned and the inferiority of steel axles insisted upon? The answer is that no maker of tires can afford to put inferior material into his product, because detection would be prompt and the inferiority of the metal shown beyond question. The weaving part of an axle, on the other hand, is out of sight, and an inferior article is seldom detected until breakage happens. If the same material were put into axles that must be put into tires, breakages would be practically unknown. A good reliable steel axle can be made at lower cost than a first-class iron axle, and the former will be much more reliable than the latter; but the prevailing rage for cheapness is bringing upon the market steel axles so poor that there is little to choose between them and muck-bar iron. We recently had the privilege of examining etchings made from a steel axle that failed in service, the study of which was rather edifying. There was an annular ring of fairly dense metal on the outside and the whole of the inside was porous like a bad steel casting. The hammering given to the axle was of the most perfunctory kind. The makers of the axle, when remonstrated with for turning out such a poor article, defended themselves on the grounds that the price paid was so low that they could not afford to make a good axle. It is apparent that the purchaser was to blame for the accident caused by the breakage of that axle, and that it was another case of dear cheapness.

Some years ago, when steel axles were growing into favor, we learned of a superintendent of motive power who specified steel axles for a lot of cars, and found that nearly all of the axles sent out on the first order failed under the M. C. B. drop test. They were all sent back and good axles supplied which passed the test successfully. We were able to follow up the matter further than the makers of the axles expected. We found that the returned axles were all put into stock to be sent to some road which did not indulge in making tests. The concern made two qualities of steel axles. One kind was intended to pass the M. C. B. drop test; the other kind might pass, but were likely to fail. All the axles were cheap material, poorly worked, and would give little satisfaction in service; but they were of steel, and the best grades of this material have to bear the reproach caused by the failure of axles made merely to sell. When railroad companies are purchasing wheels weighing 600 pounds for $5.50 each, it cannot be expected that they will pay a decent price for axles.

The breakage of an axle is likely to lead to such serious consequences that railroad officers, with anything in the shape of a conscience, ought to be ready and willing to provide against this form of disaster. The proper safeguard is to show a willingness to pay for a first-class article. When this disposition becomes generally manifest, good steel axles will soon crowd inferior iron out of the field. Bessemer steel is not fit for the making of axles. In connection with the willingness to pay a fair price, there should be a determination to see that the article supplied is up to the mark. Manufacturers, as a rule, try

to be honest, but it is a good plan for purchasers, by means of strict tests and rigid inspection, to guard against mistakes. Those who have not got a testing department of their own ought to employ specialists to do the work. The man who is willing to take material on faith is not doing justice to the company he represents. Makers of a good article are always willing and ready to have it properly tested.

Cars Will Be Built Stronger.

No subject is creating so much attention among railroad men as the proposed change in the rules of interchange of cars which will hold owners of cars responsible for the greater part of the repairs done to their cars while on foreign roads. The greater part of the railroads running into Chicago are now trying the plan referred to, so that they can have experience of how it works before moving to incorporate it as a part of the Rules of Interchange at next M. C. B. Convention. According to the latest reports received, the plan is working very satisfactorily and is facilitating the movement of cars. This was the end desired much more emphatically than any regulating of justice between railroads concerning who was entitled to bear the cost of repairing cars. The existing plan had become intolerable. It caused so much delay in the movement of freight that there was a likelihood of railroad managers taking the entire control of interchange of cars away from the Master Car Builders' Association rules.

The objections raised to the proposed change in the rules by Mr. R. P. C. Sanderson, in our last issue, have excited widespread attention, but the prevailing belief is that the difficulties pointed out can be overcome. Mr. Sanderson's paper formed the subject of a discussion at the New York Railroad Club, and the consensus of opinion expressed was that the calculations based on the cost of car service on the equipment of a small road like the Western & Atlantic, do not apply conclusively to present conditions. There is a belief among many railroad officers that the benefits received from the change, in the shape of reduced delays in freight, will be sufficient so justify increasing the allowance for mileage.

The experience of those who are trying the new plan is, that the roads noted for having weak cars are brought into prominence by the extent of the repair bills. This is right and proper. The burden is reaching the shoulders that ought to carry the weight. Those who have been in the habit of building inferior, weak cars, that connecting roads had to keep in repair, find that their own miserable chickens come home to roost. A change which makes it of self-interest for railroad companies to build strong, substantial cars, is something to be commended, even if it has no other merits.

Changing Specifications.

A subject which has excited much talk among railroad officials during the last few months is the successful effort made by certain car building firms to hang up a large contract for cars, on the grounds that numerous proprietary articles were specified for the cars. The objections raised against the specifications in question are of a character that define two contending interests. On one side there are railroad companies striving to secure cars that are first-class in every particular; on the other side are the car manufacturers who are struggling to obtain all the profit they possibly can on the cars which they build. To make good profit they naturally wish to supply every article which is used in the construction of a car. Those who are in the best position to judge say that no good specification for cars was ever awarded that the recipient of the contract did not immediately proceed to have it changed. This is notoriously the case with the Pullman people, who never fail to use all the influence at their command to substitute the proprietary articles in which they are themselves directly or indirectly interested for those specified. Several other car builders are little behind Pullman in this respect. When a car manufacturer seeks to change the specification under which a contract has been awarded, he is acting like the butcher who sends a customer veal after he has paid for lamb, and excuses himself on the ground that veal is more durable eating. Few customers would stand this kind of treatment from a butcher, but railroad men stand analogous treatment all the time from car manufacturers and others.

It is safe to say that a poor, cheap car costs one-fifth more to keep in running order than a first-class car. This being the case, the head of the mechanical department, in designing a new car, naturally wishes to specify good quality of the parts that call for most repairs. He is familiar with the different roofs on the market, and selects one which will in his judgment last during the life of the car. Experience has given him deep insight into troubles with common doors, and he specifies forms which insure satisfaction. Renewing car couplers is an expensive item, and he selects one which is noted for durability, and he puts in a device calculated to keep down the damage to draft appliances. He likes a particular brake beam and specifies it, and he dislikes six-dollar wheels, so he protects his company against the dangers of broken wheels by specifying the make. The designs of other parts are regulated in a similar manner, with a single eye to durability.

A manufacturer bids on the specifications submitted and gets the contract. Then he begins figuring on what he could save by changing certain parts. A cheaper roof, common doors, common body bolsters, a weaker truck, and all other parts specified changed, would save him considerable money. He makes representations to the man who was responsible for the specifications that he could make an equally good car if he would be permitted to make certain changes, and the permission would be taken as a personal favor. The permission is refused. Then the car builder goes higher. He represents to the general manager or president that the car specified is very odd in many parts; that there is no reason in the world why certain things should be specified, unless it be to favor certain interests; that if he will be permitted to build his own standard car he will guarantee it to be as good or better than the car specified, and he will drop the price so much a car, saving the company a large aggregate sum named. The G. M. very often permits the change to be made, and they get a car that begins to fall apart from the first day it leaves the builders. The managers who are doing their best for the interests of their company, however, stand by their specifications and secure a first-class car. If a railroad company is going to accept the standard car of any builder, the sensible way is to call for bids on that basis. Then the purchaser would get the benefit of free competition. The securing of a contract by bidding on specifications, and then having them changed by scheming, is merely a species of underhand cheating.

Every competent motive power man in the country knows all the best attachments that are calculated to make a first-class car. When he orders these, he is acting for the best interests of his company, and he has the right to have them.

Things We Want to Know About Locomotives.

The test departments which our leading railroads have kept in operation for years have done a great deal to settle engineering problems over which there used to be great diversity of opinion, but there are many others still unsettled. If the proposed tests by the Railway Master Mechanics' Association on the locomotive testing apparatus at Purdue University can ever be carried out, they will settle beyond dispute many things that it would greatly profit railroad companies to know with certainty. A locomotive is operated under conditions so different from a stationary or marine engine, that rules of good practice in the operating and handling of the latter types may be decidedly wasteful when applied to locomotives. Good engineering as applied to stationary practice is advocated as good engineering for locomotives, but there are good reasons for believing it leads to expensive mistakes.

There are numerous things connected with steam distribution on which there is now conflict of opinion among good authorities. Among these are the practice of throttling the steam, the extent of valve travel, the size of steam ports and the lap dimensions. There is good reason for be-

lieving that proportions which will give good results when an engine is working heavy may be the reverse of economical for lighter service. The proper grate area for average service is by no means settled. Another question on which increase of light is greatly needed, is the volume of air that can be admitted above the fire with advantage. The people interested in smoke-preventing appliances insist that economy of fuel results from the admission of sufficient air above the fire to prevent smoke generation. We doubt this. If the exact quantity of air necessary to maintain perfect combustion is mixed with the fuel gases there will be no smoke, and the maximum heating power will be secured from the fuel, but in a locomotive it is impracticable to measure the exact volume of air required, and, consequently, excess of cold air is the rule, and waste of heat nearly always results from attempts at smoke prevention. Valuable information on this subject would be facts about where gain ceases and losses begin.

There is a certainty that high speed of trains leads to increase of fuel consumption, but in what proportion increase of fuel stands in relation to increase of speed there is no approximate knowledge. Take a train of, say, 150 tons exclusive of engine and run it over the same track at different speeds—say 10, 20, 30, 40, 50, 60 miles an hour—and find out the fuel burned. Information of this kind would be useful to railroad men, and would enable them to figure intelligently on the cost of slow and fast trains. The whole of the tests could be made on the Purdue University engine in one day. Railroad managers who refuse to aid in the Railway Master Mechanics' Association tests are not acting for the best interests of railroad economy.

Discipline Without Punishment.

Most of our readers will remember the article which appeared in LOCOMOTIVE ENGINEERING a year ago, written by Mr. Geo. R. Brown, general superintendent of the Fall Brook Railroad, describing the working of his system, which maintains discipline without punishment. The fundamental principle of the system is the doing unto others as you would be done to. The ordinary practice followed by those in charge of railroad men is to hold all employés, good and bad, in equal favor until something happens for which punishment is inflicted. The Brown system reverses this, and puts in practice the idea that good conduct deserves recognition and reward. Those guilty of misconduct are punished by receiving no reward.

When we published details of this system it excited widespread attention. Mr. Brown received many inquiries for more detailed particulars, and not a few railroad officers visited the Fall Brook Railroad to watch the operation of the system. They found that it had put almost a stop to the species of accidents due to the carelessness of employés, had made the men keenly vigilant in promoting the company's interests, and had resulted in reduction in operating expenses with an improved service.

These facts were so convincingly apparent that several railroad officers decided to try the system on their lines. The change was so radical from the preconceived notions of how to treat railroad employés that managers were doubtful if it would work successfully on other lines than the Fall Brook. A few roads ventured to try the system, and it works so well that there are hopes that the Brown system will in the course of time be adopted on every railroad where the managers are willing to act with full justice towards the men under them. There is a great deal of loose talk about finding means to make the rank and file of railroad men more loyal to the company they work for. We advise them to try the Brown system of discipline without punishment.

Among those who adopted the Brown system was Mr. F. G. Darlington, superintendent of the Pittsburgh, Chicago and St. Louis at Indianapolis. He read a paper lately describing the system and the working of the system, and commending it in the highest terms. Under the working of the Brown form of discipline, the charges against the men have decreased, accidents have diminished, and the expenses of operating have been made smaller. If these results are not of sufficient importance to commend the system to others, it is because those following old methods are so hide-bound to bad practices that they will rather put up with inferior service than make changes which would bring better returns for the money paid out.

Railroad business, as a rule, is still very dull compared with what it was two years ago, but signs of improvement are everywhere visible, except on the roads that depend for much of their business on the districts in the West, where the drought of last summer caused a failure of crops. An encouraging feature of the present condition of things is that railroad companies are beginning to purchase supplies. They are not purchasing because they have money in abundance, but because they cannot get along without making purchases. The scrap heaps have been exhausted as sources of material, and rolling stock and track have been run down as they never were before. Tracks are full of locomotives and cars waiting to be repaired, and material must be purchased to do the work with. If the country should be fortunate enough to raise good crops this summer, there will be a rush for the purchase of cars and locomotives that will send the wheels of industry humming. As it is, more orders for new cars and locomotives have been given out within the month than there have since the panic came on.

The secretary of the Master Car Builders' Association has issued a circular giving the prices of all the M. C. B. types of couplers in use. There are eighteen of them. The prices vary from $9.50 to $12.50, five of them being quoted at the latter figure. A very desirable reform in the control of this car-coupler business would be the establishing of some uniform rule regarding renewals. Under the existing rules, there is temptation for companies replacing drawbars to put in the cheapest coupler upon the market. As there is $3 difference in price between the highest and the lowest, the temptation to save that sum in replacing couplers belonging to other people is too strong for the virtue of some men in charge of car departments, who are looking out to get ahead of their neighbors. The cheapest couplers are not really the worst on the list, but they are inferentially inferior to those that cost $3 more. We have repeatedly heard complaints lately from railroad companies using the more expensive couplers, that when breakage happens to their couplers on certain foreign lines they are replaced by the cheapest kind of standard couplers on the market. There is no remedy at present under the M. C. B. rules.

The chairman of one of the most important committees appointed by the Railway Master Mechanics' Association, visited this office last month. On being asked how his committee work was progressing, he answered that he had not received a single response to the circular sent out asking for information. This is decidedly discouraging to those who look for exhaustive information in the reports. There was a great deal said at last convention about the necessity for getting the reports ready in good season, and the sentiment appeared to be that there would be no more reason for complaint about circulars not being answered. The indications are that the performance is going to fall very much short of the convention promises. It is late now to send answers to circulars, but not too late. We would therefore urge delinquent members of both associations to examine their pigeon holes and set aside a rainy day to perform the pleasant duty of answering circulars.

BOOK REVIEW.

MACHINE TOOLS, by William Sellers & Co., is supposed to be this concern's illustrated catalogue, but it is more of a high-class work on machine tools than there is for sale on the market. This book is unique in several ways. Its get-up is new; it is $7\frac{1}{2} \times 7\frac{1}{2}$ in., but was probably well in hand before the M. C. B. standard size was adopted. Half-tone cuts of a high order are used, and the machines and devices illustrated are legion. Some of the special tools built by this concern are the finest examples extant of recent engineering. It is a book to be sought and appreciated by those using machine tools or interested in the results accomplished with them.

PERSONAL.

Mr. G. S. A. Gardiner, of Providence, has accepted the position of sales agent for the Graham Equipment Co., of Boston.

Mr. George Morrison has been appointed road foreman of engines of the Beach Creek Railroad. He has been for years an engineer on the road.

Mr. William W. Molchoir has been appointed train dispatcher of the Chicago, Milwaukee & St. Paul, at Racine, Wis., in place of Mr. E. W. Northrop, resigned.

Mr. C. H. Barnes, master mechanic of the Boston & Albany, at Springfield, Mass., has been transferred to Boston as master mechanic, to succeed Mr. T. B. Purves, Jr., promoted.

M. E. Johns, formerly on the N. Y., S. & W. Railroad, has been appointed train master of the Wilkesbarre & Eastern Railroad Company, and is located at Wilkesbarre, Pa.

Mr. W. A. Williams, heretofore general superintendent of the Texarkana & Fort Smith, has been appointed general manager of that road, with headquarters at Texarkana, Tex.

Mr. Stott Mills has resigned the position of master mechanic of the Lehigh & Hudson. He is open for another engagement, and is a good man for any railroad wanting a master mechanic.

Mr. H. Trim, formerly master mechanic of the Ohio Southern, has been appointed superintendent of shops of the Peoria & Eastern division of the Cleveland, Cincinnati, Chicago & St. Louis.

Mr. T. C. Scott, heretofore chief train dispatcher of the Iowa division of the Chicago, Rock Island & Pacific, has been appointed trainmaster of that division, with headquarters at Davenport, Ia.

Mr. W. W. Willock, of Allegheny, Pa., has been appointed general manager of the Monongahela Connecting Railroad, with headquarters at Pittsburgh, Pa., to succeed Mr. W. C. Quincy, deceased.

Mr. I. H. Brown, who has been a locomotive engineer on the Cincinnati division of the Chesapeake & Ohio, has been appointed traveling engineer of that road from Hinton to Clifton Forge, W. Va.

Mr. A. J. Ball, until recently master mechanic of the Columbus, Sandusky & Hocking, has been appointed division master mechanic of the Cincinnati, Hamilton & Dayton, with headquarters at Dayton, Ohio.

Reports have been published in most of the railroad papers within the last month that Mr. W. H. Taft, acting superintendent of motive power of the Boston & Albany, has been made purchasing agent. There is no truth in the report.

The rumor which we mentioned last month of Mr. W. J. Reed having been appointed superintendent of motive power of the Seaboard Air Line is correct. He succeeds Mr. James Maglenn, resigned. His headquarters are in Raleigh, N. C.

Mr. Mike Grace, the well-known traveling engineer of the Northern Pacific, has left to accept a similar position on the Monterey & Gulf Railroad in Mexico. The B. of L. E., Division 144, passed resolutions of regret that Mr. Grace has gone away.

Mr. T. S. McDowell has been appointed division superintendent of the Waco, Houston, San Marcos and Trinity divisions and Belton branch of the Missouri, Kansas & Texas, of Texas, with headquarters at Taylor, Tex. He has heretofore been trainmaster.

Mr. George Hebert, heretofore shop clerk, has been appointed general storekeeper of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn. Mr. G. A. Gipple has been appointed shop clerk in place of Mr. Hebert.

Mr. David Clark, for forty years master mechanic of the Lehigh Valley, has retired. Mr. Clark is president of a bank, and has other important private business interests which give him all the work he can do without the worry of a master mechanic's position.

Mr. John L. Handy has been appointed chief clerk in the office of the mechanical superintendent of the Grand Trunk railway at Detroit, Mich. Mr. Handy was formerly in the mechanical department at Battle Creek, Mich., and was one of our most successful club raisers.

Mr. E. L. James, chief clerk of the motive power department of the Boston & Albany, at Boston, has been elected secretary of the New England Railroad Club. Mr. James has been with the Boston & Albany people for twelve years, and is very familiar with the subjects discussed at the Railroad Club.

Mr. George W. Mudd, foreman of the shops of the Wabash Railroad at Fort Wayne, Ind., has been appointed master mechanic of the road, with headquarters at Springfield, Ill. He is succeeded as foreman of the shops at Fort Wayne by Mr. W. S. Cooper, who has been foreman of the shops at Montpelier, O.

Mr. J. W. Maxwell has been appointed general superintendent of the entire Texas system of the Missouri, Kansas & Texas, with headquarters at Denison, Tex. He has heretofore been division superintendent at Denison. The department of maintenance of way has been transferred from the supervision of the chief engineer to that of the general superintendent.

Mr. Thomas B. Purves, Jr., master mechanic of the Boston & Albany, at Boston, has been transferred to Springfield, where he will have charge of both locomotive and car shops. There is no truth in the reports published that Mr. Purves had been appointed superintendent of machinery. He is the first master mechanic of the Boston & Albany to have jurisdiction over any part of the car department.

Mr. R. W. Harris, formerly road foreman of engines of the Greenbrier and New River districts of the Huntington division of the Chesapeake & Ohio Railroad, has been appointed master mechanic of the Kanawha & Michigan Railway, with headquarters at Charleston, W. Va. Mr. G. W. Hepburn, formerly night roundhouse foreman, was promoted to the position of general foreman at Hinton, W. Va., *vice* J. F. Redaker, deceased.

Mr. F. W. Chaffee, head foreman in the car department of the New York Central & Hudson River, at West Albany, N. Y., has been appointed master car builder at the West Albany shops, to succeed the late Loren Packard. Mr. George E. Kinnear, foreman of the car repair shop, has been advanced to the position held by Mr. Chaffee. Mr. William Smilie, foreman of freight car repairs, succeeds Mr. Kinnear, and Mr. Leonard Truax succeeds Mr. Smilie.

Colonel Boies, president of the Boies Car Wheel Co., Scranton, is examining the methods of transportation practiced on the Nile. Before he went to Egypt, some of his antiquarian friends wished him to examine the Pyramids and see if he could find any specimens of the car wheels used by the ancient Egyptians. If he finds any remnants of those belonging to Pharaoh's chariots, he is under contract to give LOCOMOTIVE ENGINEERING the privilege of first publishing particulars.

Mr. F. W. Mahl has been appointed mechanical engineer of the Southern Pacific, with headquarters at Sacramento, Cal. Mr. Mahl was for several years in the Schenectady Locomotive Works, first in the drawing office and then on testing and inspection work. He is a graduate of an engineering school, and is unusually well informed concerning the designing of rolling stock. He is a son of Mr. William Mahl, New York assistant to President Huntington, of the Southern Pacific.

Mr. S. R. Tuggle, superintendent of motive power of the Chesapeake, Ohio & Southwestern, has been appointed superintendent of motive power and machinery of the Houston & Texas Central, with headquarters at Houston, Tex. Mr. Tuggle has been with the C., O. & S. W. since May 1, 1893, and was, before that date, for nearly eight years master mechanic of the Kentucky Central. From 1882 to September, 1885, he was master mechanic of the Elizabethtown, Lexington & Big Sandy.

Mr. J. V. K. Walker has severed his connection with the Seaboard Air Line, having been employed as air-brake inspector for the past three years. Mr. Walker is now engaged in the mercantile business, consisting of hats and men's furnishings. He

has been offered the position of air-brake inspector of the Florida Peninsular & Central Railroad of Florida, with headquarters at Fernandina, but having gone into business, was compelled to refuse, much to his regret. Mr. Walker continues to receive subscriptions for LOCOMOTIVE ENGINEERING at his place of business.

Mr. Philip Wallis, for some years assistant superintendent of motive power of the Norfolk & Western, has been appointed master mechanic of the Lehigh Valley at Hazleton, Pa. He will have charge of shops at three places. The Lehigh Valley people are fortunate in securing the services of Mr. Wallis, for he is one of the ablest mechanical engineers in railroad service. He is a technical school graduate, with the kind of practical training that enabled him to fill successfully the duties of general foreman of a railroad shop. He was engineer of tests for the C., B. & Q. for several years, and afterwards was advanced to be master mechanic at Bairdstown, Ill. Some of the most valuable tests carried out by the C., B. & Q. were conducted by Mr. Wallis.

Mr. H. H. Vreeland, president of the Metropolitan Street Railway, New York, continues to take as much interest in surface railroad affairs as he did when he was president of the New York & Northern. His warm interest was pleasantly manifested on the day of the last meeting of the New York Railroad Club, by his inviting a large party of the members to visit the splendid power house of his company at Houston street and Broadway. The inspection of the magnificent machinery was highly interesting to the railroad men. The details of the huge engines, the cable-driving and regulating machinery, and all the electric and hydraulic appliances, revealed to many of those present a scale of mechanical powers they had no idea of. A remarkably pleasant afternoon was wound up with an attractive banquet served in Mr. Vreeland's office.

Mr. E. St. John, who recently left the Chicago, Rock Island & Pacific to be vice-president of the Seaboard Air Line, was, during his long connection with the former road, known as a particularly warm friend of the engineers and of the Engineers' Brotherhood. The men recognized this, and on his leaving, a movement was started to present him with some suitable token of respect. Some valuable presents were spoken of, and the required money could have been easily collected; but they first found out Mr. St. John's sentiments, and they were that he would not accept presents. The committee then had a set of resolutions artistically engrossed, expressing the regards of the employés for Mr. St. John. The memorial was signed by fifty-four of the locomotive engineers, including all those who have been longest in the service of the company. Of the fifty-four only one has been in the service as little as 10 years; thirty-three have been over 20; twenty have been over 25; ten have been over 30, two of them over 35—the last two being C. H. Davis (37 years) and J. E. Mousley (38 years). Mr. George Royal, of the Nathan Mfg. Co., was appointed to make the formal presentation to Mr. St. John, and he went to Portsmouth, Va., for that purpose.

Mr. Frank G. Woodman has been appointed general foreman of the Great Northern shops at East Spokane, Wash. Mr. Woodman was formerly foreman of the erecting shops of the Brooks Locomotive Works.

We have received a copy of the eighth annual report of the Bureau of Labor Statistics of North Carolina. As many of our readers know, the well-known locomotive engineer, Benj. R. Lacy, is the commissioner in charge of this bureau. Ben is not a professional politician, as we note he recommends the abolition of his own office unless the Legislature appropriates enough money to make the affair a success. We guess the North Carolinians appreciate Ben, for we see by late Raleigh papers that he has been reappointed and confirmed by the legislative body.

We have had scores of letters for "an air-brake book that asks and answers questions," but there has been no such book on the market until now. The standard authority has been the instruction book formulated by the Westinghouse people and adopted by the Master Car Builders' and Master Mechanics' associations. Traveling Engineer C. B. Conger has taken this standard work and added to it a list of over 90 questions and answers that make it the best authority for engineers and firemen, and the plainest. It is illustrated and right up to date; pocket size. For sale, price 25 cents, by LOCOMOTIVE ENGINEERING.

EQUIPMENT NOTES.

The Wheeling & Lake Erie have ordered three locomotives and 300 box cars.

The Cooke Locomotive Works are still busy on their Southern Pacific order.

The Central Railroad of Georgia are building 200 cars in their own shops.

Orders were received for 47 sets of the Leach sanding apparatus in February.

The Gulf & Interstate Railroad of Texas is in the market for locomotives and cars.

The Columbus, Hocking Valley & Toledo are reported to be in the market for 900 cars.

The Pittsburgh & Lake Erie have ordered six ten-wheel engines from Pittsburgh.

The Grand Rapids & Indiana have ordered four consolidation engines from Baldwins.

The Delaware, Lackawanna & Western have ordered 500 cars. The Fox truck is specified for them.

Rogers' people are working on an engine for the New York & New Jersey, and on a small order for Cuba.

Among the rumors of coming car orders is one from the Savannah, Americus & Georgia for 300 box cars.

The Indiana Car and Foundry Co. have received an order from the Vandalia for 110 box cars, and 511 stock cars from the Mathers Stock Car Co.

If the number of cars reported by gossip to have been given out had really materialized, all the car builders in the country would be running full time.

The United States Metallic Packing Co. have opened a new branch office in Cincinnati, with Mr. A. H. Pike in charge. Mr. E. N. Hurley takes charge of the Chicago office.

The Gould Coupler Co. have put upon the market a pilot coupler of the vertical plane type, by which cars can be coupled closely to the pilot of the locomotive. The design is very neatly worked out.

The suit of the Westinghouse Air Brake Co. against the Boyden Power Brake Co. for infringement of the quick-action patents, has been decided in favor of the Westinghouse people. Judge Morris wrote the decision, and it is remarkably strong in sustaining the quick-action patents.

We are informed by the American Balance Slide Valve Co. that they have their valve in use on 63 railroads in this country. It is also in successful operation on railroads in Canada, Mexico, Central America, Germany, France and Scotland, and is now being applied to locomotives in Switzerland.

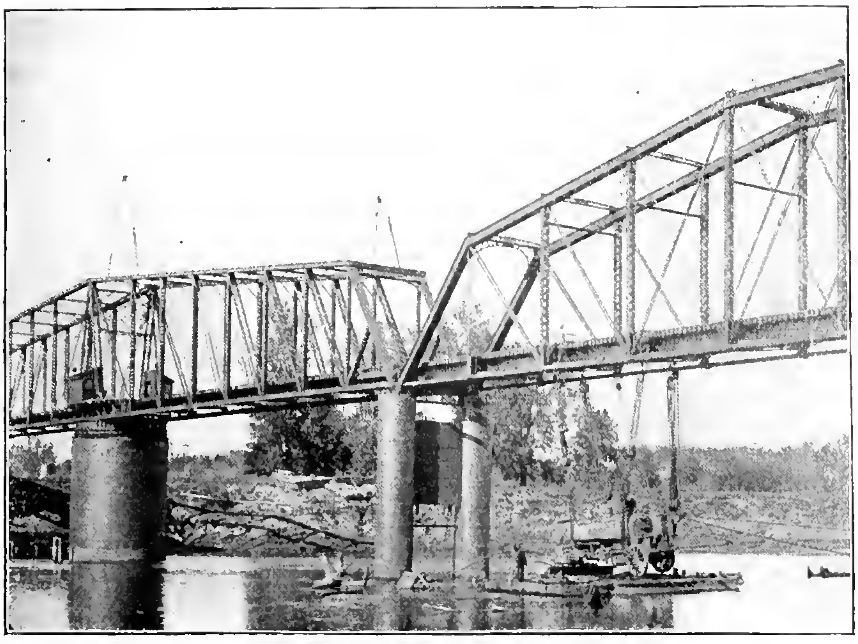
The Big Four have ordered six eight-wheel passenger engines from Schenectady. They are exact counterparts of the last lot of passenger engines purchased. The same company expect in the near future to give out orders for the building of passenger, box and stock cars. The business on the road is better than it was in 1892.

The Baltimore & Ohio are running between Baltimore and Chicago one Campbell-House combination car, for the purpose of obtaining experience of its utility. By a few internal changes this car can be made suitable for carrying stock or merchandise. The experience has been so favorable that they are getting nine new ones built.

The Standard Steel Works of Philadelphia, makers of the "Standard" tires and steel wheels, are putting up open-hearth furnaces in which to make their own steel. They have been in the habit of purchasing the steel ingots from the best makers, but the quality furnished has not been uniform enough to satisfy the Standard people.

Back from the Grave.

Some time ago we mentioned the fact that General Master Mechanic Galbraith, of the St. Louis & S. W., had raised a locomotive from the dead, one that had been dead and buried for seven years and three months. We are now enabled to show photographs of the engine as she appeared



when hauled out of her grave by the body-snatchers.

This engine went down with the bridge, August 6, 1887. She was under several feet of water and twelve feet of quicksand. The raising and repairs only cost $2,000, and she was ready for service five days after she got back on the rails. She has been in regular service ever since.

The resurrection act was done by Wreck-Master W. H. Grace, under the supervision of Mr. Galbraith.

Favors Engineering Literature.

The traveling engineers appear to appreciate the value of engineering literature as a means of helping the enginemen to do their work better. At the last convention of traveling engineers at Denver, a report stated that eight roads supplied Angus Sinclair's works to their men.

President Conger said: My experience with this matter of furnishing firemen or anybody else with any literature except time cards, is that if they buy their own literature and make some effort to get it, it is twice as valuable to them, and the fellow that doesn't get any literature, finally gets weeded out. If we weed out pretty close, when a man gets near the bottom he commences to climb again, and we keep the lower stratum on the move all the time to keep out of each other's way.

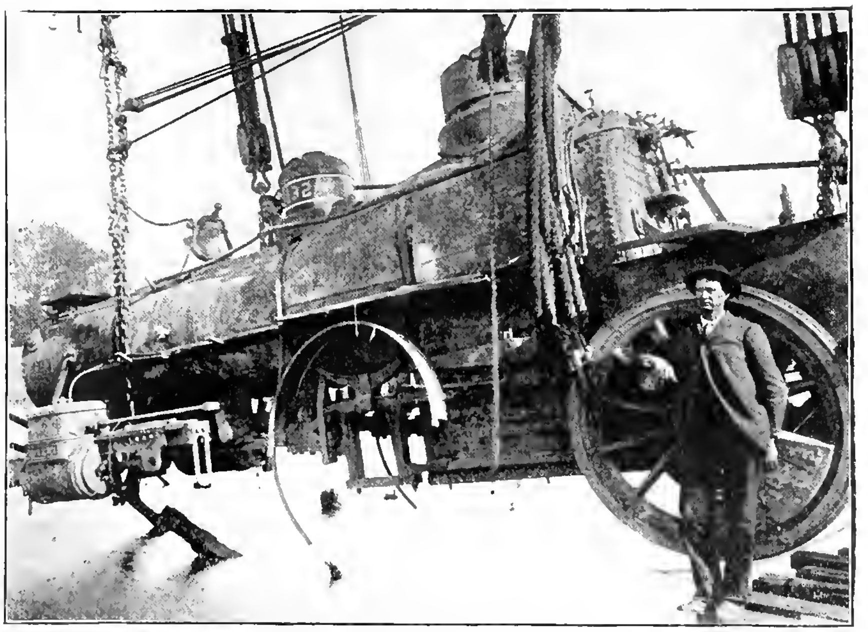
Mr. Scott: I think that any book of information that is published and furnished in that way is not always necessary. In my traveling about the road, I have had a good deal of missionary work to perform from time to time, and the assistance I found most valuable was LOCOMOTIVE ENGINEERING. I took quite an active interest in obtaining subscribers for that along the line, and I found that the average man is more apt to read and reflect on what he reads when it is furnished him in small doses. I find since they have been reading that paper, as a rule they have some questions or some remarks or comments on some particular thing they have seen in the paper, and they are always eager to get it the next month. I believe a publication of that kind is indispensable to every locomotive engineer and fireman. I know that it has helped me out a great deal, and I have always advocated the men subscribing for it.

Mr. McBain: My experience in that matter has been the same as Mr. Scott's. I find that the railway papers such as LOCOMOTIVE ENGINEERING have done more to educate the men, in a technical way, than any other literature they ever possessed.

President Conger: I can reach some of my men by writing an article in some of the railway papers when I can't touch them out of the roundhouse or on the engine at all. I explain it to them and they say yes, yes, and listen respectfully, and go off and think about something else. When they get their LOCOMOTIVE ENGINEERING, and get their feet up after supper, and read it, they believe every word of it. That is worth a great deal of trouble, and there have been several that I reached the very night the paper came to them. I had been unable to reach them in years of talking to them. I believe in encouraging firemen and enginemen in taking periodicals, even if it is a little less than cost; sometimes it pays to be an agent. You get a man waked up and he is worth that much more to your company.

The Air Brake Men's Meeting.

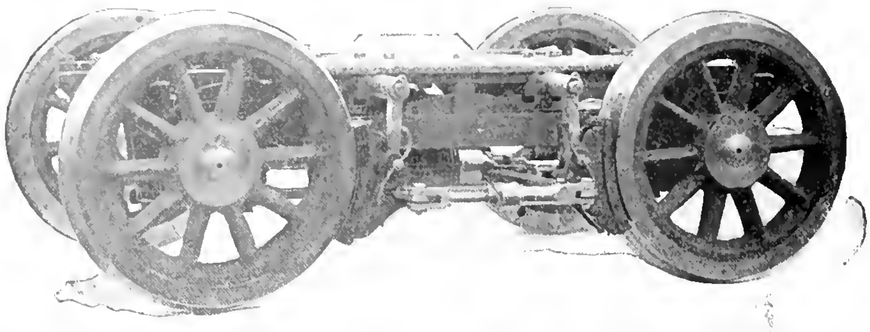
The Air Brake Men's Association will meet in St. Louis on April 9th. There are 130 members now, and the meeting promises to be an interesting one. There will be papers on the following subjects: "Pump Governors and Air Gages;" "Foundation Brakes;" "Care of Signal Apparatus and Conductor's Valve;" "Care of Engineer's Brake Valve;" "Economical Oiling and Cleaning of Brake Cylinders;" "Main Reservoir and Connections;" "Maintenance of Freight and Passenger Brakes;" "Handling of Trains on Mountain Grades;" "Driver and Engine Truck Brakes;" "Slid Flat Wheels;" "Slack Adjusters;" "Piston Rod Packing."



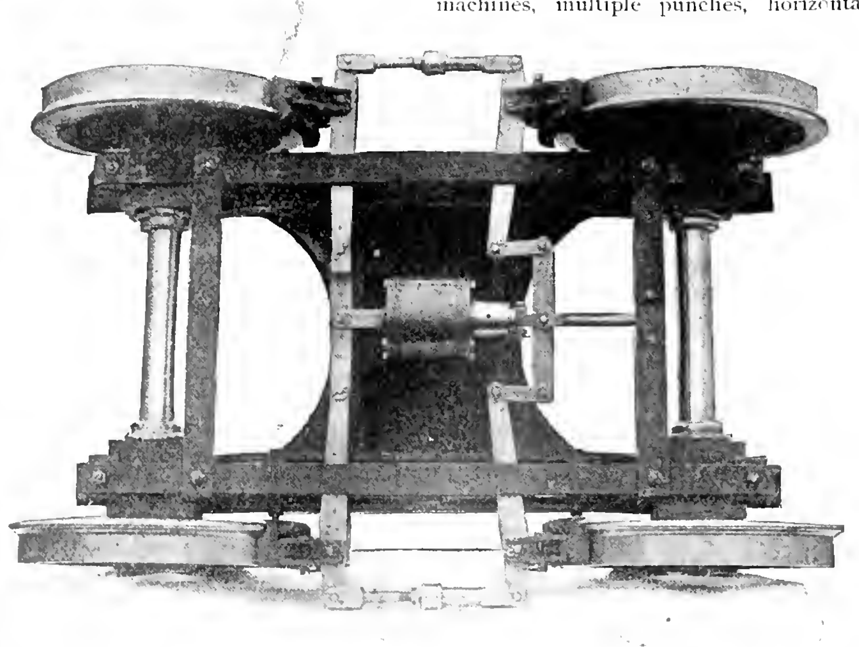
A MODERN RESURRECTION.

Application of Air Brake to Engine Trucks.

Quite a number of readers have asked us how the air-brake rig was arranged on the trucks of engine "999," and other recent locomotives. Here is an answer at a glance; the excellent photographic reproduction needs no explanation. The upper view

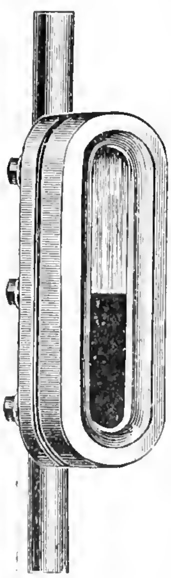


shows the side of the truck; the second view shows the bottom of the truck and the arrangement of the cylinder and levers.



An Unbreakable Gage Glass.

The United States Metallic Packing Co., of Philadelphia, Pa., after exhaustive tests, have taken hold of the manufacture and sale of the gage glass shown herewith. This glass is a plate ⅝ of an inch thick, and polished; it is annealed by a process that makes it impervious to changes of temperature. With 200 pounds of steam inside of it, a stream of ice-water fails to crack it. The glass can expand and contract between its packings.



It is made so that it can be placed on a boiler now provided with a glass tube, without changing fittings. It needs no guard whatever; cannot be struck by fire tools, except the blow is intentional, and it takes more than an ordinary blow to break it—in fact, the fittings themselves can be broken easier than the glass. There is no tendency for it to cut out, as there is in tubes, as the "scour" is always at the top, and in this device the top is solid metal.

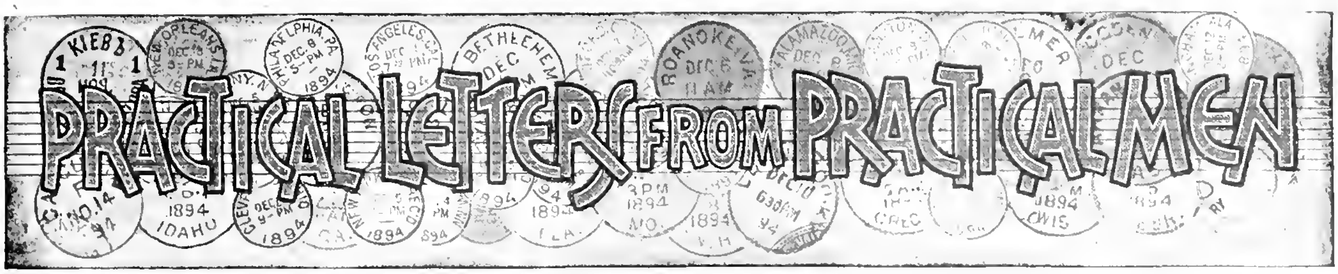
In a recent issue, a correspondent asked some questions about the American injector, and we expressed the belief that there was no such injector on the market. We have since received from the American Injector Company, of Detroit, a notice intimating that they have been in the manufacturing business for twelve years. They will answer any question about their injector which may be sent in.

"Cast-Iron Chilled Car Wheels" is the title of an illustrated pamphlet issued by the Association of Manufacturers of Chilled Car Wheels. It contains in very convenient form all the rules and regulations adopted by railroad associations in regard to chilled wheels, and gives a very good history of what has been done in recent years to enhance the quality of this kind of wheel. There is an interesting description of the manufacture of chilled wheels, with valuable information concerning the principle of chilling iron. The Master Mechanics' and Master Car Builders' specifications and guarantee for chilled wheels are also given, and a variety of other information that will be found very useful for railroad men. The pamphlet has been prepared by Mr. W. W. Lobdell, secretary for the association. Those who desire to have convenient information concerning chilled wheels ought to apply for this pamphlet. It is very artistically got out, but has the defect of not being cut according to any of the Master Car Builders' standard sizes.

The Franklin Institute of Philadelphia have awarded the Longstreth Medal of Merit to William F. Mattes and John F. Lewis, the inventors of the Lackawanna Lubricating Company's "Locomotive Cylinder Lubricator." The merits allowed for the lubricator are: Absolute uniformity of feed under all conditions, no readjustment being needed in an all-day run; perfect distribution of oil to two or more cylinders; self-filling feed glass; only one glass, which is short and stout; simplicity in design, and convenience of operation and low cost; and avoidance of passing oil into the boiler, which is accomplished without the use of check valves.

The Hilles & Jones Co., of Wilmington, Del., have just published a new illustrated catalogue, which is got out in a most attractive and artistic style. The frontispiece represents pieces punched out of plate by the various machines made by the company. Engravings are shown of single punches or shears, combined punches and shears, fish-plate punching machines, multiple punches, horizontal flange punches, universal shears, plate shears, bar and billet shears, gate shears, single and double angle-iron shears, patented beam-coping machines; plate-bending rolls, engine and pulley driven; plate-bending rolls, hand power; plate-straightening rolls, plate-planing machines, spacing tables, flanging clamps, drilling machinery and vertical milling machines. The engravings are masterpieces of art, some of them being beautiful half tones and others wood cuts. Catalogue is marked "J," 1895, and is of the M. C. B. standard size, the same as LOCOMOTIVE ENGINEERING.

Certain boiler users in the neighborhood of Detroit have obtained remarkably good results in preventing incrustation and corrosion of tubes, by coating them over with graphite paint. The graphite adheres to the tube and prevents lime salts from forming a coating. The Michigan Central Railroad and the Chicago & Grand Trunk people have been investigating the effects of this paint on tubes with a view to adopting it for locomotives.

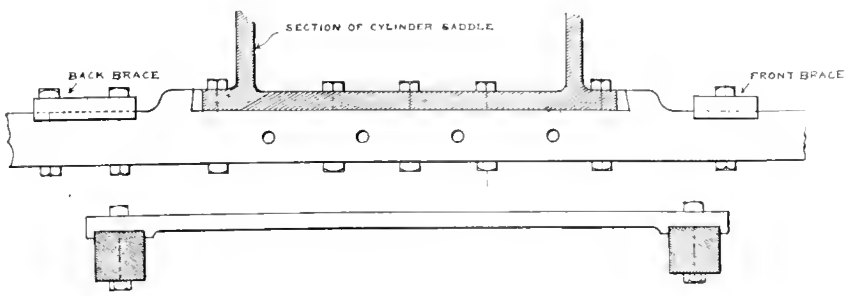


Stay Rods Through Flue Sheets.

Editors:

In the February number of your paper an account is given of Mr. Buchanan, of the New York Central, having heavy rods put through tubes from front to back flue sheets to reduce the annoyance of leaky flues. This same thing was done by me in 1893 on about half a dozen engines, when I was assistant master mechanic of the Fremont, Elkhorn & Missouri Railway, and proved a very great help in preventing leaky flues. It has since been discontinued for causes unknown to me.

E. DAWSON, M. M.,
Osceola, Ia. Des Moines & K. C. Ry.



Stiffening Plates for Cylinders and Frames.

Editors:

The remarks and illustrations in your March issue in reference to stiffening plates for locomotive cylinders, we can vouch are correct, for the reason that we have been using them on some of our consolidated engines for about twelve years. But we did not use the angle iron that Rogers Locomotive Co. bolts to back of cylinder saddle.

We did not consider the angle iron necessary, although we did conclude that in making new cylinders we could cast a flange on the back of saddle to suit the plate and then bolt the plate to it. Not finding this necessary, we never went further. These engines had only 130 pounds steam pressure. Probably with engines now being built for 180 pounds steam pressure, it may be necessary to use the cast flange or the angle iron as described.

We got into this method of stiffening plates through an engine or an engineer who was very persistent in breaking the bolts holding the two cylinders together. We used a wide plate taking all the splice bolts, and in addition we bolted a piece of iron *to the plate*, about 3 in. wide by 1 in. thick, with four bolts to form a gib against the insides of the frames. This brace assisted the splice bolts from side thrusts.

After the stiffening plate was put on, it settled the business. Our only trouble then was to keep the smokebox and saddles secure.

We have to use something similar to stiffening plates on our heavy passenger engines, to prevent cylinder getting loose or cracking of saddles.

In this case we use a brace front and back of cylinders, as shown in inclosed sketch. These braces prove very satisfactory.

Your remarks in reference to cast foot plates versus the tail pieces are also in order. It is just as necessary to tie the frames firmly at the back end as at the cylinders to insure a good job. We make a practice of firmly securing the back end.

DAVID BROWN, M. M.,
Scranton, Pa. D., L. & W.

Tool for Spiral Grooving of Eccentric Sheaves.

Editors:

Some years ago there was quite a discussion in mechanical papers, pro and con, in regard to the benefit of having an oil groove cut around the outside of eccentrics.

If the groove is cut so as to come directly under the oil hole, unless you use a plunger cup, it was held that all the oil would run out of the cup while the engine was standing, and, of course, would make the eccentric more liable to heat. It was also held that the groove was a good thing, as by it you could see how the eccentric was wearing without the use of a pair of calipers.

The greatest drawback to a groove cut straight around an eccentric is that it, in wearing, leaves a ridge on the strap, and should you want to replace an eccentric with a new one you could not do it unless the strap is rebored.

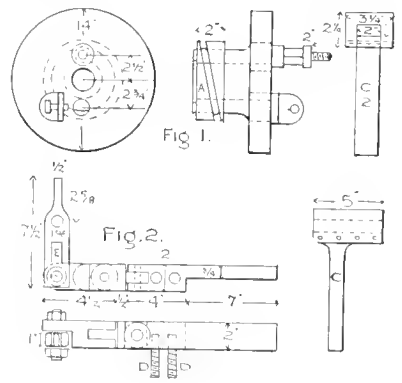
We have devised an attachment to the lathe on which we turn our eccentrics, whereby the groove, instead of being cut straight around, runs diagonally across from one side to the other.

Our method for finishing eccentrics is as follows: We first bore them out to size, then we have a face plate (Fig. 1) into the face of which a stud is screwed the exact distance from the center that the eccentric is. It is 2 in. in diameter outside of face plate, but threaded $1\frac{1}{4}$ in. in plate; the center of this stud is square, so as to screw it in by; there is also a driver on opposite side with a set screw. This drives against the spoke of the eccentric. Then have nuts for the different sizes of eccentrics that fit the stud. After putting on nut and eccentric, have clamp on outside to be tightened with nut on out end of stud.

There may be as many holes in face plate as there are different throws of eccentrics.

To cut the grooves, the first thing is to have a band shrunk on back of face plate *A*, Fig. 1, with a groove in it. This groove is $\frac{1}{2}$ x $\frac{5}{8}$ in., and has a throw of $1\frac{1}{2}$ in. To the head of the lathe is fastened a plate 1 x 2 in., and bent out at the top and having a pin fastened in it that comes in line with center of lathe and center of the throw of groove, and $2\frac{5}{8}$ in. from bottom of groove, to take the hole *B*, Fig. 2.

C, Fig. 2, is the part that goes in tool



post; the shank is the same size as the steel used for tools; the projecting part is box shape $\frac{3}{4}$ x 2 x 5 in.; for the piece carrying tool to slide in, the tool is $\frac{1}{2}$ x $\frac{1}{2}$ in., and is held by clamp and two studs *D*, Fig. 2.

The slot *E*, Fig. 2, is for changing the length of stroke to conform with width of eccentric.

There are two joints, one to allow for

variations in height and the other to allow for the tool to be worked in and out.

This attachment is as easily put on and off as a common tool and does the work perfectly.

You have a groove that will not be always below the oil hole, and this groove will carry the oil across the eccentric.

One more thing in its favor is that it will not wear a ridge in the strap, and you can see just where and how much your eccentric is wearing without the use of calipers and know that you are right.

W. A. ROBERTSON.

Cedar Rapids, Ia.

Those Flat Spots.

Editors:

If your correspondents who blame a full throttle and close cut-off (an abomination of itself) will watch their engines starting a heavy train, they will notice that while the crank pin is passing through the lower quarter the wheels will slip just a little, but enough to start a flat spot. Now, if the right wheel slips at this point, it also produces a flat spot on the left tire, and while the left crank is passing through the forward part of the stroke; at least, such has been my experience in watching my engine starting a train.

W. DE SANNO.

Indianapolis, Ind.

Don't Agree with Conger About Leaks in Engineer's Valve.

Editors:

Being an interested reader of LOCOMOTIVE ENGINEERING the last four or five years, and handling the air brake, as an engineer on the N. Y. C., I have studied considerable into its workings. I was interested in Mr. Conger's article in the March number, but I cannot agree with him when he says that the black pointer, or hand, of air gage will not show train-line pressure. I claim that it will at all times, if brake valve and connections are in good order. He claims that by putting the valve handle on lap, and opening cock at rear of tender, and discharging all air from the train pipe, that if all connections with equalizing reservoir and valve are tight that the black pointer will not fall any. I claim that it will fall to the peg; all it wants is a very little time. He claims that to find a leaky rotary, with a pressure of 70 and 90 pounds, lap the valve and close cut-out cock under valve—pressure will increase on black hand if rotary leaks. I agree with him in this; but if the rotary should happen to make a joint over preliminary exhaust and supply ports to cavity over piston, how would your black pointer indicate your leaky rotary by pressure rising, if it does not go through the ring in equalizing piston, which I claim is the same opening that will show train-line pressure at all times.

JOHN J. PLUNKETT.

Syracuse, N. Y.

Two Questions for the Boys.

Editors:

Having run across two problems recently that I should be glad to have someone solve, I herewith submit them: Four mogul locomotives, of a special design, wore one cylinder in some cases and both in others, away on the top side so bad that rings couldn't be pened to make them fit when it was necessary to put in new ones. The cylinders were worn from front to back end almost the same, and averaged $\frac{1}{8}$ to $\frac{1}{4}$ in. Other engines of the same class and build were not afflicted this way in the least. I have but one solution, and perhaps that is wrong.

The guides were of two-bar type—one on top, the other under a broad crosshead, with brass gibs or slides top and bottom. The guides were correctly lined and not tampered with to adjust any wear of gibs. The wear was not distributed over the half of circumference, but was only about 8 in. across the cylinder, which was 17 in.

The other puzzle is this: An engine with vacuum brakes on drivers and tender, showed 18 in. on gage when brakes were applied with a pressure of 80 pounds steam, and only 12 in. when the steam was 140. The needle wasn't loose on the spindle, nor any obstruction on valve that closes relief opening. I have no theory as to the cause, and hope the boys will let me down light.

A. A. BROWN.

Waycross, Ga.

Correction to Boiler-Making Article.

Editors:

My attention has been drawn to several points in my articles that need correction. One is in Fig. 115—the circumference is laid out upon a straight line and, as a consequence, it would be too long. Draw arcs through *E F* and *I J* from the same center *H G* is drawn from. Or extend *X Y* and *P G* (Fig. 113) till they cut each other, then from the vertex to the lap holes will be the radius for *E F* and *I J*. Draw *H G* midway between the two. Lay off the circumferences upon these arcs; space them off, draw lines through these points and convey the lengths as given.

In the stack base, the point of looking at the front and side of the cone was not properly covered. Draw Fig. 124 as shown, but add the line *R A* at right angles to *A E*. Set the trams from *R* to *E* to draw the arc *J R* (Fig. 126). As the end *R A* will be an ellipse, add *R A* and *A C*, then divide by 2 for the proper radius. Lay off the circumference upon *J R*, space it off and number same as Fig. 126. Measure the length of the ordinates between the lines *A R* and *C A* (Fig. 124), and mark them upon the radial lines (Fig. 126), measuring from *J R*. This will be the line for flanging. Draw a plan or top view same as marked *plan*, one quarter is sufficient; space off each of these quadrants, then measure from No. 1 in one quadrant to No. 1 in the other; mark this length upon the line *D B*, measuring from and to the right of *B*; convey the other lengths to this line, and the diagonal line from 1 to *A* will be the length of the radial lines No. 1 between *J L* and *R U*; mark the other diagonal lengths upon the similarly numbered radial lines, measuring from the center marks for flanging, and a line drawn through the points will cut to form absolutely correct.

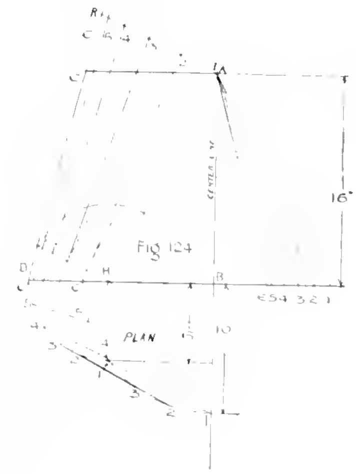


Fig. 124

The engraver has failed to show the short marks outlining the camber in Fig. 122, and the marks 2, 3, 4, 5, etc., giving the length of the ordinates in Fig. 128, but the lengths can be secured in Fig. 129, between *H G* and where the short arcs cut the similarly numbered ordinates.

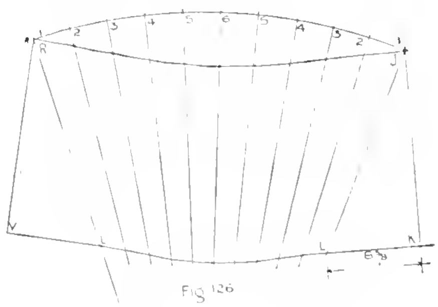


Fig. 126

Dubuque, Ia.

C. E. FOURNESS.

Automatic Air Brakes Without Triple Valves.

Editors:

Every little while I am called upon to examine an invention having for its object the construction of an air brake which will be automatic without using any triple

valve. Few, if any, of the patentees seem to be aware that they are treading a path which is already old and worn, and I then have the rather unpleasant task of showing that the fundamental ideas of such an apparatus have been known almost since the

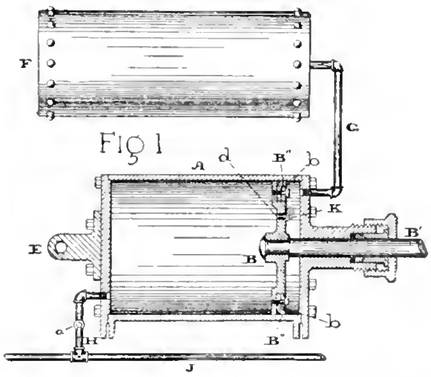


Fig 1

beginning of the existence of the old straight air brake. I confess that the thought of being able to make an automatic brake without any triple valve is a very attractive one, and such a brake has, without question, some advantages over the kind which use triple valves, but there are objections to their use on long trains that make their introduction undesirable, if not impracticable.

My attention was first called to this scheme by Mr. Sutton, formerly air brake man at Boone, Ia., on the C. & N. W. Ry., while in conversation with him as we were sitting on the edge of the platform of the transfer station at Council Bluffs, about five or six years ago. He illustrated his ideas with a rough sketch, and immediately I became very much interested, as I at the time, saw the advantages much more clearly than the disadvantages. His plan was to construct an experimental device from a tender cylinder, putting a stuffing box around the piston rod. The train-pipe connection was made at one end of the cylinder, the reservoir pipe opening into the other end. When air from the train pipe entered the cylinder it forced the piston to the release position, when the leakage groove (in this case the feed groove) permitted the reservoir to become charged. To apply the brakes, train-pipe pressure was reduced, the reservoir pressure, of course, forcing the piston out and applying the brake. The great advantage of the device was, that when it was desired to make a partial release it was possible to

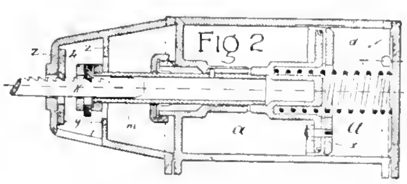


Fig 2

accomplish it very nicely by simply letting a slight amount of air into the train pipe from the main drum.

Since the time of the experience above mentioned I have become considerably more familiar with what has been done in the air-brake line in days gone by, and from the large number of patents which have been issued showing automatic brakes without any triple valves I have selected a few for purposes of illustration, which are here reproduced.

Fig. 1 is one of the earliest. It was patented by S. F. Prince in 1878. The train pipe is marked *J*, the cut-out cock, *a*, and the piston *B*. Air entering the cylinder *A* moves the piston to the position shown, and opening the small check valve *K* fills the reservoir.

When the train-pipe pressure is reduced the check valve *K* closes, and the air in the reservoir forces the piston to the left, which, through a pull on the rod *B"*, applies the brakes.

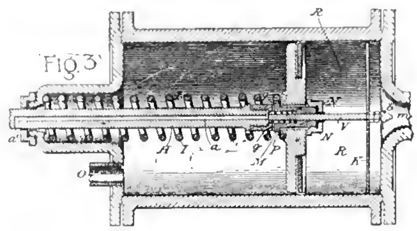


Fig 3

Fig. 2 is taken from a patent issued to J. F. Carpenter in 1881, and shows an arrangement which operates in substantially the same way.

The train pipe is connected at *c*, and the reservoir fills through a leakage groove *d*,

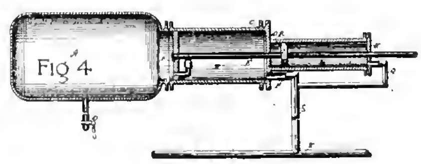


Fig 4

the parts as shown being in release position.

This patent is interesting in another way, as showing a form of automatic slack adjuster composed of a washer or washers around the piston rod, which dropped into

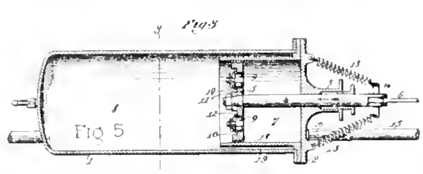


Fig 5

a new notch whenever the shoes became worn so as to make the piston travel too far.

Fig. 3 was patented by Mr. Sjogren in 1884. The train-pipe connection is marked *O*, the pipe leading to the reservoir *m*.

In this no valve is necessary, because air can pass to the right around the packing leather, but not in the opposite direction. The diaphragm *K* and stem *V* are for the purpose of making an opening for the escape of train-pipe and cylinder pressure through the port *a'* when the brakes are applied.

Fig. 4, from a patent taken out by A. G. Easton in 1886, is another arrangement of the idea, having as a check valve in the piston a little ball shown just under the piston rod. This shows also a scheme for doing away with the release spring, the air pressure against the piston *I* being substituted in place of it.

Fig. 5 was an idea originated by Mr. A.

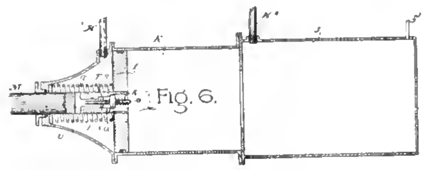


Fig. 6.

Silcock, and patented in 1892. In this a series of check valves were used in the piston, his opinion evidently being that it was essential that the reservoir should charge very rapidly. The arrangement of the release springs in this apparatus is an interesting thing to note.

Fig. 6 was patented by J. Erdody in 1893. The method of operation is obvious from the drawing. In this, as in all the rest, we see the piston balanced between the train-pipe and reservoir pressure, and the check valve or passage through which the reservoir is to be charged. The patent also shows the use of a second train pipe, but that is auxiliary and has no bearing on what this article is intended to illustrate.

Fig. 7, taken from a patent issued to J. D. P. Schenck in 1894, shows practically the same arrangement as the one of Fig. 1, issued in 1878, but has the check valve in a by-pass around the piston instead of in the piston head itself.

The patents specifically described above are only a portion of those which show practically the same general idea, and gazing at them all together, the thought is naturally drawn to the conclusion that there is considerable truth in the old saying: "There is nothing new under the sun."

A question may naturally arise in the minds of some as to how it is possible for so many different people to secure patents on devices showing mechanism so much alike. To understand this, it is necessary to understand that what a patent may

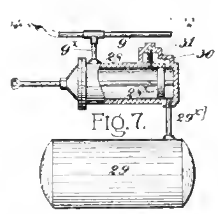


Fig. 7.

show and what is contained in the claims are two very different things. The claims in these several patents may be and, in fact, probably are, very different, each covering something in the nature of an improvement in some detail which, for purposes of illustration, must be shown in its relation to the whole.

PAUL SYNNESTVEDT.

Chicago, Ill.

Are Leakage Grooves of Any Use?—Drainage of the Drum and Pipes.

Editors:

Shortly after the quick-acting triple valves were first applied to passenger cars, I was sitting, one day, on a baggage truck at the station, when a passenger train cut off a car and left it on the track directly in front of me; from where I was sitting the car-brake cylinder was not ten feet away. Suddenly something happened about it that attracted my attention. The cylinder piston was slowly moving out. It traveled only four or five inches, no more than tightening the gear, when there was a light discharge of air from the exhaust port in the triple valve, the piston moved back again and the brake was released. A few seconds later the piston started out again, the release occurred and the piston returned. This peculiar action kept on repeatedly—as long as I sat there—four or five light applications and releases. It happened a long time ago, when the quick-action triple valves and I were both new, and I couldn't account for such peculiar action; not sure that I can now, but I don't think that the emergency valve or apparatus was involved.

I had not thought about that funny brake for a long time; until Mr. Hamar, in the March number of this paper, presented a case something similar, reminding me of it; for I believe that each occurrence may be attributed to the same main cause.

I will begin trying to explain his puzzle by suggesting a slight leak of auxiliary reservoir air on car No. 2, probably at the release cock. This would draw air from the train pipe of both cars until the auxiliary reservoir pressure of car No. 1 would be enough greater than the train-pipe pressure that the triple piston would move down against the graduating stem and apply the brake on car No. 1, the air flowing from auxiliary reservoir to brake cylinder through the graduating valve. The brake on car No. 2 could not apply, because the pressure was leaking away from *above* its triple valve, coming from the train pipe through the feed groove.

The graduating valve on car No. 1 leaked—it pulled open and applied the brake; but when auxiliary pressure was reduced by flowing into the brake cylinder, to a slightly less pressure than that of the train pipe, and the triple piston moved to close the graduating valve, this leaking graduating valve would not stop the flow of air until the pressure in the auxiliary reservoir was so far reduced that the frictional resistance of the slide valve was overcome, and when the slide valve moved there was nothing to restrain it; it made a full upward stroke and released the brake.

If this will explain the incident related by Mr. Hamar, I have no doubt that there was a similar defect of the triple valve on the car whose brake I noticed acting so queerly; but in the case I have mentioned, the leakage was from some point in the train pipe instead of from the reservoir of another car.

Somebody will take exception to this explanation, and calling attention to the fact that there must be but a very slight leak from the train pipe to allow for the brake releasing itself, will want to know—"How about the leakage groove in the brake cylinder, and why will it not prevent the brake applying when the leak is so slight that the train pipe will retain an air pressure enough to release the brake?"

I want to say, that with the triple valve as it is now constructed, I believe that as a preventative of brakes applying from leakage, or a too light discharge of train-pipe air, the leakage groove in the brake cylinder is nothing but a theory—seldom effective—particularly in the use of quick-action triples, whose slide valves are large and cover so much of the seat that there is a heavy resistance to the movement of the triple piston. When this resistance has been overcome, and the auxiliary pressure has the piston moving, I see nothing to prevent it going along until it strikes the graduating stem, at which point the graduating feed port in the valve is in register, fully, with the port to brake cylinder in the seat.

There is more or less leakage around and past the triple piston when it is not seated on its leather at lower end of the stroke, and I believe that this piston leakage is the real cause of some triples in a train failing to respond to a very small and slow reduction of train-pipe pressure. A case of this kind will be explained, however, to enginemen, trainmen and others, that "there wasn't air enough discharged to close the leakage grooves." Why don't they be exact and say there wasn't enough air discharged to actuate the triple valves?

When you make your first discharge of train-pipe air, in applying the brake, your auxiliary air is about 70 pounds pressure per square inch. Now, suppose that you measure the face of the slide valve of a quick-action triple, and having found the area, multiply the number of square inches by 70; that will give the number of pounds pressure that holds the slide valve to its seat, and it will surprise one that there is such great resistance to the initial movement of the triple valve. It is why the first application of the brake must be a discharge of 6 or 8 pounds (Instruction Book). The resistance of the slide valve and the leakage of the triple piston must both be overcome, and when the pressure of air in the auxiliary reservoir does become enough greater than that in the train pipe to start the triple valve moving, why should the triple stop at a point where the ports in the slide valve and its seat are so little more than edge to edge with each other, that the leakage groove will pass off all air that enters the cylinder? I don't believe that the triple will stop there, and if there is enough train-pipe leakage to move the piston and slide valve, a leakage groove in the brake cylinder will not prevent a service application of the brake.

The leakage groove in brake cylinders was introduced at the time when triple valves were "spring graduating." A discharge of train-pipe air heavy enough to pull the triple valve down against the graduating stem would not apply the brake; then the graduating feed port in the slide valve was not in register with the port to brake cylinder, but was very close—nearly line and line—and a greater reduction of train-pipe air was necessary, in order to compress the graduating spring so that the triple would pull down far enough to admit the air through the graduating valve into the port to the brake cylinder, and when the auxiliary reservoir pressure was reduced to an equilibrium with the train-pipe pressure, the graduating spring pushed up the triple piston and closed the graduating feed valve.

In that old-style triple valve the graduating spring *was* a graduating spring, and it thus derived its name.

Now we have *air graduation;* the triple valve is in service-stop feed position when the piston is resting against the graduating stem, and the graduating valve will close by the pressure of train-pipe air when the auxiliary pressure has reduced to less than the pressure in the train pipe. The graduating spring is still an important feature in the triple-valve arrangement; it doesn't exactly graduate, but it prevents the full force of the auxiliary reservoir air from entering the brake cylinder at service application, and in a quick-action triple valve it has the same duty to perform, besides restricting the emergency action of the valve.

When triple valves were spring graduating, the leakage grooves in the brake cylinders really did what is claimed for them now. The train-pipe leakage would cause the triple piston to move down against the graduating stem, where it would pause, until from further leakage it was able to compress the spring. As the graduating spring compressed, it stiffened and its resistance increased, so that the feed ports in the slide valve and its seat were brought together very slowly, and the triple was ready to stop the instant that there was the least relief of auxiliary pressure; and it is quite possible that the triple valve would stop in its downward movement the instant that the slightest escape of air occurred from the auxiliary reservoir to the brake cylinder, and the flow of air would be so light that the leakage groove could convey it from the cylinder without the piston moving.

Instead of being a benefit to the service, the leakage groove is sometimes a detriment. In extremely cold weather it is not unusual for the piston-packing leather to freeze to the cylinder, and if the groove is open, some of the braking pressure will waste through it in a service application; maybe the leather will not pull loose at all unless the brake is applied at emergency.

Possibly some brake failures in zero weather might be traced to the leakage groove.

My ideas are heretical, but I am not altogether opposed to a *groove* in the cylinder. This winter several correspondents have called attention to the evil effects of water in the air pipes and reservoirs, but have said nothing about it being present in the brake cylinder, where the whole work is performed. It does collect there sometimes, and when it does it may be of more detriment than if it were anywhere else in the system. Water is often found in tender brake cylinders behind the piston, and ahead of it, too, due to tank leakage. An old air-brake repair man called my attention to it the other day, and said that if the leakage groove was put in the *bottom* of the cylinder, and a small hole drilled in the bottom of the cylinder at the extreme back end, the "leakage" groove would be of some benefit; that it would keep the brake cylinder dry and clean. So it would.

As to the subject of drainage: Why are not better facilities provided for draining the main reservoir and tender auxiliary? There is usually a plug in the bottom of the main reservoir that must be unscrewed with a wrench, and in loosening it, one is sprayed all over with a nasty mess if there is any air in the drum; and the engine must be over a pit, or the reservoir won't be drained at all. The tender auxiliary is stowed away some place where you can't reach it easily, and it don't get drained often, either. It, and the main reservoir, should each be fitted with a cock or valve, for drainage, to which a rod is attached like those connected to freight-car release valves; and if other parts of the air-brake system on engine and tender, where water can collect, were made easy to drain, much trouble would be prevented thereby, and brakes would work better; no moisture could get back into the pipes of the train.

Water is largely responsible for renewal and repair in air-brake maintenance; it corrodes and rusts metal, rots leather and rubber, and is a better medium for conveying dirt, scale, sand, cinders, etc., than air is. Engineers would rather use air alone in their brakes than air and water, and, if they could do so conveniently, would drain their reservoirs and pipes every trip.

It is easy enough to answer Question 7 of the Traveling Engineer's air-brake examination questions, "How often should the main reservoir and pipes be drained?" But if the question was asked, "How often *do* you drain them?" about 99 per cent. of engineers would give an untruthful or evasive answer. They don't draw the water from their brake pipes and reservoirs as often as is necessary, because they cannot do it conveniently, and weeks of constant service sometimes elapse during which engineers never catch their engines over a pit.

WILL W. WOOD.

Terre Haute, Ind.

Putting in Driving Springs.

Editors:

Referring to L. C. Noble's communication in March number, in answer to mine in February one, in regard to putting in driver springs and hangers, will say that the rule he gives is the same that is found in most books on the locomotive. I put them in that way over twenty years ago; I have an easier way now. Some six or seven months ago I stood in a crowd and watched an engineer put in a spring, old style—the left front one was broken. He had left back wheel run up on a wedge high enough to bring front pedestal binder up to box; that took back box and equalizer way up and front end down. There were about six or eight men with two or three pinch bars helping him; in the course of time they managed to pry and block up front end of equalizer a little above level, then they coupled up back end of spring, and in the course of time, by "bull strength and awkwardness," they pried down front end and coupled it up. While they were at it I told the engineer that there was an equalizer hook on back end of tender (I had run that engine a short time before), and I was going to advise him how to use it, but he gave the crowd a knowing wink and remarked that the way he put in springs he didn't have to disconnect equalizer.

L. C. Noble says that "if the springs are properly designed they can be applied as well as hangers without disconnecting equalizer, or the use of a hook and lever to pull them down." Now, there is nothing peculiar about our engines here; they are Baldwins, Rogers and Rhode Island, and we use the same kind of springs that came with them. I have never yet been able to put in a spring without using a great deal of force to get down end of spring enough to couple to hanger. I have put in a good many springs, and I find it far easier and quicker to disconnect equalizer than couple up hangers and pull down and couple up equalizer again. If you are out on the road and have no block like the one I described, the next best way is to use a wedge, but always run back driver up on wedge, no matter which spring or hanger is broken; then put a block between front driver box and frame to hold what you have got, then run engine off the block; that will let down back box. Now, when you get in spring or hanger, you will have to run up on wedge again to get out the block you put in between front box and frame. Now, you have made two trips up on wedge, and had trouble to find block to put over top of driver box, especially with some styles of box and saddle. The way I described in February number, you would put one end of block on a tie, the other end under tail frame, back engine up on it, and when you get in spring or hanger run her down and you are done.

I have talked this matter over with a number of men who have had a good deal of experience, one of them as roundhouse foreman, and they say that they never came across one of those "properly designed" springs that L. C. Noble speaks of.

ORANGE POUND.

Bartow, Fla.

Hamar's Air-Brake Puzzle.

Editors:

I should like to try my hand on Friend Hamar's air-brake puzzle. Under the conditions given, I believe brakes could have set but from two causes—either the train-pipe pressure was reduced below that of the auxiliary reservoir, or the latter pressure increased above that of the train pipe, which could happen if there was a foreign reservoir attached to and taking its air supply from the auxiliary. In the former case there must have been a small leak somewhere in the train-line volume, perhaps on car No. 2; and car No. 1 undoubtedly had a leaky graduating valve in her triple valve, if no exterior leaks in auxiliary reservoir could be found, and the chances were that the leakage groove in brake cylinder was stopped up, or, perhaps, missing, which is not unusual at all. In car No. 2, the leakage groove in brake cylinder was open or brake much harder to start. Now, if the train-pipe pressure reduced, say two pounds, and the piston packing ring in triple valve was in good condition, the slide valve could have been pulled down and admitted air through the graduating port to brake cylinder, putting the brake on slightly, because cylinder packing was tight at the start. The graduating valve closing imperfectly, permitted the air in auxiliary reservoir to leak through to brake cylinder, after the pressure between it and train pipe had equalized; in this way reducing below train-pipe pressure, which, being then the strongest, returned the triple piston and slide valve to release position when brake went off, only to repeat the operation when train-pipe pressure had again leaked below that in the auxiliary reservoir. In case of foreign reservoirs spoken of, say Frost light, for instance, the train pipe could have been tight and the check between auxiliary reservoir and the one supplied from it could have been at fault. In this case, say the train-pipe pressure when engine was cut loose was 65 pounds, and while on the road 70 pounds, the extra reservoir would have charged to 70; but in switching, the auxiliary reservoir pressure was reduced in setting brakes and not recharged; the check valve leaking would raise the auxiliary reservoir pressure to above 65 pounds, when brake would apply; the graduating valve leaking would again release it, when the train pipe would lose a little of its air through recharging auxiliary reservoir, and once more the extra reservoir would get in its work, and this would continue as long as there was enough pressure to work the brake.

GEORGE HOLMES.

Roanoke, Va.

Answer to Hamar's Question.

Editors:

In answering my question which was published in March number, will say that the cause of brakes applying and releasing without any apparent reduction of pressure in train pipe, was due to leak in release cock on auxiliary reservoir on car No. 2. The leak being very slight, and the two cars detached from engine, source of supply was cut off; then, after standing short time, the air leaking from the auxiliary through the release cock would naturally cause a drain of pressure from the train pipe of car No. 2; the triple valve being in release position, pressure in auxiliary and train pipe of car No. 2 was thus kept equalized until reduced lower than pressure on car No. 1. Car No. 1 now having higher pressure, No. 2 drew the air from train pipe of No. 1, reducing it below the auxiliary pressure, forcing triple valve to application position and applying the brakes. When pressure in train pipe and auxiliary in No. 1 was equalized by air expanding into brake cylinder, it then remained slightly lower than the pressure on car No. 2, causing slight drain from No. 2, which had the effect of recharging train pipe in No. 1 to such an extent as to release the brakes.

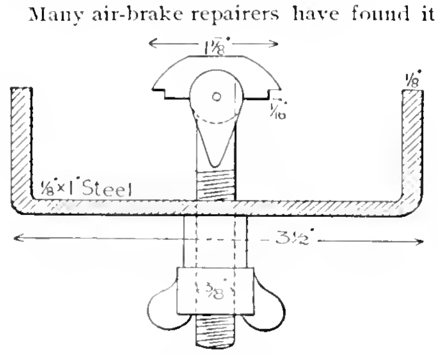
W. T. Hamar,
Road Fmn. Engines, So. Ry.
Atlanta, Ga.

Device for Pulling Emergency-Valve Bushings.

Editors:

Inclosed you will find a sketch of a little device for pulling emergency-valve seats on standard passenger triples.

Many air-brake repairers have found it



difficult to remove this seat from the body of the valve without using a thin chisel. The device having a swing head readily adjusts itself, and draws the seat, without damage, to even the gasket.

W. H. Durant,
Air-Brake Inspector, C. & M. R.R.
Concord, N. H.

How to Secure Independent Driver Brake and Not Interfere With the Automatic.

Editors:

After having read a number of articles written in regard to the merits of independent and continuous driver brakes, I have come to the conclusion that I should not be doing my duty to the readers of your most valuable paper if I did not tell my experience in regard to this matter. I am of the same opinion as Wood and Shaffner in regard to the necessity and value of an independent driver brake, but am sure the continuous driver brake should not be sacrificed for it. Having come to that conclusion, I looked for a way so as to have both. At the time we were running gravel trains of 40 cars each, 20 to 25 of them air brakes, down grades varying from 76 to 85 feet per mile; the cars being heavily loaded, it made a very light braking power, and the use of an independent driver brake was of great help when recharging auxiliaries.

But where I found it of most use was at the gravel pit, in stopping the cars at the right place to be loaded, and also on the road when unloading. The engineer not being able to stop right every time when using the continuous brake, and also on account of the great amount of air used, the pump was continually out of repair. This caused me to find a way to have an independent and continuous driver brake, which I obtained by piping from the exhaust port of the triple valve (located under the footboard where the engineer stood, as these were consolidated engines) up into the cab, and made a connection through a three-way cock to the main reservoir pipe, and near the cock, between it and the triple, I placed a safety valve set at 50 pounds. In one position of the three-way cock the pipe from triple was open to the atmosphere and the main reservoir connection was closed, and in another position, obtained by moving the handle one-quarter of a turn, the opening to atmosphere was closed and an opening from main reservoir to the driver-brake cylinders established—providing at the time the handle is placed in this position the triple is in the release position—and the driver brakes will be applied independent of the train brakes; and when a pressure of 50 pounds is obtained the safety valve will blow, and the cock can then be partly closed, so as to prevent any great waste of air and yet maintain the full 50 pounds pressure in the brake cylinders.

When the brake is to be used to bunch a train before applying the train brake, the safety valve, set at 50 pounds pressure, should be located on the end of a pipe in the cab, which connects with one of the driver brake cylinders; this will prevent the obtaining of more than 50 pounds pressure in the cylinders, where it will not do so when connected to the pipe connecting the exhaust port of triple with three-way cock.

It will readily be seen that with a cock arranged in this way it can be used as a pressure-retaining valve or for applying the driver brakes independently, and yet not interfere with its working as a continuous brake. I also ran a pipe from the auxiliary up into the cab, so if it was desired at any time, when the train brakes were applied, to apply the driver brake independently, it could be done by allowing a little of the auxiliary air to escape there by causing the triple to move to release position.

E. G. Desoe,
A. B. Inspector, B. S. & A. R.R.
Springfield, Mass.

On Changing Rule 8.

Editors:

In your March issue you refer to a statement made by Mr. John Mackenzie of the Nickel Plate, at a meeting of one of the Railroad Clubs, which, if correctly given, is in substance that the reason why railway companies are inclined to favor the extensive alteration and enlargement of Rule 8 of the M. C. B. Code is that private lines are said to pay less than 40 per cent. of the cost of maintenance of their cars, and that the railways have to pay the other 60 per cent. Mr. Mackenzie is reported to have said that under such circumstances rules should be made to hold owners responsible for the condition of their cars.

In this question it must be remembered that there are always two classes of car owners, viz., the railways and the private lines. The latter do not own a mile of track operated as a railway, and when their cars are at home and in possession of owners, parts do not, as a rule, wear ont, fail, crack or break down. Such failures, etc., which demand outlay invariably take place while the private-line cars are in the hands of a railway company, though often in the service of the owner or unproductively returning home empty over a railway. Railway companies, when interchanging cars owned by railways, stand to one another in a reciprocal position. That is, that one railway may and often does repair as many of its neighbor's cars as its neighbor repairs for it, and the chances of failure are practically equal on both lines. Not so in the case of private lines and railway companies. When the cars of the former are in their own hands, they are "standing still" compared with actual service over several railway lines. Private lines cannot repair cars owned by a railway.

The decisions of the M. C. B. Arbitration Committee in cases Nos. 70, 120, 121, 201, 204 and 211 lay down very clearly the principle that there is a fundamental difference between the cars of a private line and those of a railway company. In case No. 211, the arbitrators say: "The practices which are customary between railway car owners in interchange are reciprocal, and must not be regarded as establishing precedents to be followed in the case of private car owners."

With these facts, and the reasons for these decisions kept clearly in view, does not the proposed alteration and great extension of Rule 8 appear like an endeavor to punish the whole alphabet, because A, B and C are refractory? The elimination of the "cared for" clause of Rule 10 and the definite enumeration of certain parts, if necessary, or a clear definition of the

meaning of "failure under fair usage," in Rule 10, would dispose of the alleged necessity for the alteration of Rule 8 to cover the case of private line cars. The discussion as to the advisability of changing the force of Rule 8 could then proceed upon more logical grounds, unencumbered with considerations which do not properly or fairly belong to the question.

GEO. S. HODGINS.

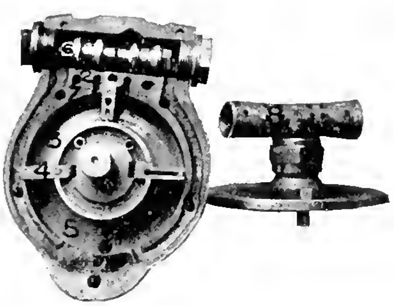
Windsor, Ontario.

A New Bell Ringer.

Mr. J. R. Bearce, general foreman of the K. C., M. & B., at Amory, Miss., has devised a steam or air bell ringer without external moving parts or connections. It is of the oscillating style of engine, and its trunnion is fastened directly to the bell

shaft. Our engravings will make plain its construction and application.

The mode of operation is as follows: Steam is admitted to center of valve, Fig. 1, through steam port 2, into cylinder 3, the pressure forcing piston plate 4 around



to opening 5, a portion of the steam passing through this opening to steam chest 6, and forcing valve to opposite end of steam chest; exhaust steam then passes back through steam port 2, through cavity at end of valve out through exhaust port 7. The valve is now in position to admit steam in the opposite side of cylinder, which gives piston the desired motion. The packing plates in piston and packing strips in end of plates, also the ring in the end of the piston, are set out by springs. Fig. 8 is the valve bushing.

Please don't write an article and ask us to publish it, "but not mention my name." All contributed matter must be signed and the address given—*for publication.*

Why Does a Locomotive Boiler Explode When It Has Sufficient Water and Working Under Ordinary Steam Pressure?

BY JAMES HUGHES.*

Having a share in the care of locomotives for many years, I will give my observations on the causes and effects that sometimes produce an explosion.

A locomotive boiler may be looked at as being composed of two parts: One, the firebox and its shell; the other, the barrel and the tubes. These two parts are joined together by what is called the connection. This and the barrel have to do about all the bending and twisting that is done in the boiler, when the engine is running over the ups and downs and all other irregularities in the track, such as sags and frogs, and striking curves.

The frames of a locomotive are regarded as two girders, and are supposed to be strong enough to bear the weight of the boiler and all that is on or in it.

The boiler and frames are secured to each other by the expansion braces at the firebox end, the cylinders at the front end, and by belly braces at intermediate points along the barrel of the boiler. The boiler and frames being bound to each other in the manner they are, it appears to be the supposition that that composition is self-sustaining, but such is not the fact, as the boiler itself indicates. I will call attention to some of the indications that show that the boiler does yield by its own weight and the situation it is placed in. Where the belly braces are riveted to the barrel of the boiler which has run any length of time, it may be found that around the edge of the rivets, inside the boiler, the sheets are grooved. If these braces are not riveted, but are brought up to the boiler so as to fit around the under side, the working of the engine will show the chafing of the braces on the boiler, indicating the resistance it must offer.

Another indication is the small cracks that take place in the upper side of the throat sheet. These are generally supposed to be effects caused by some obstruction to the expansion of the boiler. That the upper corner staybolts and others next to the flange of throat sheet are found leaking, is evidence of the strain put upon them when the boiler bends up or down. There is some spring between the flange and these staybolts, but little or none in the upper sides, where the cracks take place. This spot may be looked upon as the fulcrum of the lever, as it receives the direct crushing effect, alternating as the boiler bends. The weight of the barrel and its contents, with the cylinder bolted to the smokebox, acts like a weight on the end of a lever, keeping that end of the boiler down and binding it to the frames.

The firebox end of the boiler is, of itself, another heavy part carried by the rear end of the frames. While the connection is only a shell, generally of an irregular form, the bending takes place chiefly in that part, and extends along the barrel of the boiler. The front end of the wagon top is also affected. Those interested in this may see for themselves, when an engine goes in the shop for repairs, about how much bending there is, as it is not to be seen out on the road. Boilers that I have tried have the dome on the barrel of the boiler. I took a long straight edge, placed one end across the top of the dome, the other end extended as far as the rear end of the boiler. I then measured the distance from rear end of boiler up to the straight edge. This was done while the wheels were under the engine. While the wheels were being taken out, I measured again, and found the rear end of the boiler moved upward $\frac{7}{16}$ in., and downward $\frac{3}{16}$ in. from the first line. This boiler, measuring from rear of smokebox, is 23 ft. long; diameter of front course, 54 in.; the shell throughout is steel $\frac{7}{16}$ in. thick. The firebox is 7 ft. 6 in. x 9 ft. 6 in.; the sheets $\frac{3}{8}$ in. thick; is radial-stayed for burning fine coal.

I measured one other boiler that burns fine coal. It was 26 ft. 10 in. long; the front course was 50 in. diameter, with a conical course from it to a course 60 in. diameter, 89 in. long. The shell throughout is iron $\frac{7}{16}$ in. thick. This boiler varied $\frac{7}{8}$ in. in jacking the rear end up, and lowering it on a block near the main pedestals, the frames being connected to the boiler—of course, all moved together. Being cold, and in the shop, this springing would be similar to that when running over the high and low spots in the track. I have seen an engine headed out of the roundhouse having 140 pounds steam pressure, standing two hours, while the girth seams under the boiler were being calked. The man doing it had his cheek against it part of the time. That boiler must have been in a bad shape; the expansion raising the top and drawing the bottom up with it. This is why the girth seams leak in the bottom, extending further up the sides in a double riveted than in a single riveted seam, and causing cracks in the sheets. The boiler and frames bending by their own weight, and the expansion and contraction of the boiler, are the two causes that groove the sheets around the rivets in belly braces—these braces chafing the boiler when not riveted.

The girth seams leaking, and cracks under the boiler.

Cracks in the upper side of throat sheet.

The upper corner staybolts, and others, around and nearest the flange of throat sheet.

The flues expanded towards the firebox do their part in making these staybolts leak. These effects are to be looked for in all horizontal boilers. Even those of the best design and workmanship are not wholly exempted from these effects. The

*Foreman Boilermaker, D., L. & W. R'y, Scranton, Pa.

temperature in opposite sides of the boiler, differing as it does, has a strong tendency to disrupt the sheets in the barrel.

The weight of the boiler and frames, causing them to yield and conform to the unevenness of locations a locomotive has to run over. This conformation is another severe stress that tends to disrupt the boiler. We know of fireboxes cracking open, having neither fire nor water in them.

Again, an engine having a new steel boiler, standing in the roundhouse three months in winter, having a steam pressure of from 40 to 60 pounds; at the end of that time we would find a crack about 10 in. long, in the under side of the barrel, near a girth seam.

From the above statements it may be said that a locomotive, standing idle or working, whether there is a pressure of steam on or not, is writhing and striving to tear itself apart. When working with ordinary steam pressure and sufficient water the boiler may explode.

Those having photographs or illustrations of locomotive boiler explosions at hand will, by reference to them, find that in the majority of cases they point to the barrel of the boiler first giving way.

A New Order of Locomotive Engineers.

We have received the following communication from Mr. H. A. Burke, of Tacoma, Wash.:

The Supreme Lodge of the Independent Order of Locomotive Engineers, was organized in Tacoma, Wash., on the 2d inst.

The objects of the order are as follows:

To unite its members in bonds of truth, friendship, sobriety and industry.

To secure for them the highest possible efficiency in their profession as locomotive engineers, believing that the best interests of humanity, employers and the members themselves will be most advanced by making their services of greatest value to those engaging them.

To forward their moral, social and mutual interests, enabling them to secure honorable employment when in need.

The order requires:

That its members, as such, adopt a non-sectarian, non-political and non-strike platform, consistent with the constitution and fundamental rules for the government of law-abiding citizens.

That every member shall be a quiet and peaceable citizen, true to the government and yielding obedience to the laws that afford protection, so that in whatever country he may travel he may find a friend and brother who will do all in his power to serve him.

That all difficulties be settled peaceably and amicably, without injuring the interests of employer, employé or the public.

The chief officers are: F. R. Spalt, A. L. Marshall, and H. A. Burke, secretary.

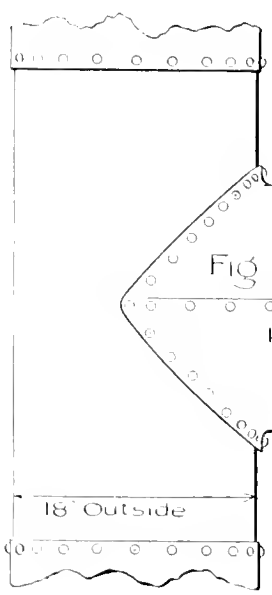
The Elements of Boiler-Making.

SHEET-IRON WORK.

By C. E. Fourness.*

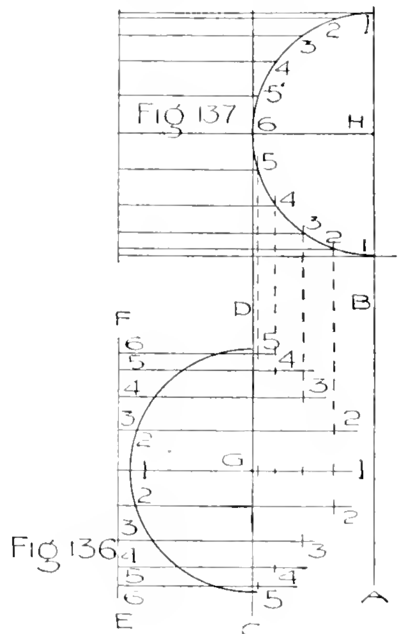
TWO CYLINDERS INTERSECTING AT RIGHT ANGLES TO THEIR AXES.

In this article will be given two cylinders 18 inches in diameter, intersecting at right angles to each other. The whole to be made of square courses, and of material No. 16 in thickness. Fig. 135 is a side elevation, showing everything all finished. But in order to lay out the sheets required for this, Figs. 136 and 137 are needed, so start by drawing the line *A B*, Fig. 136, extending it far enough to form 1 *H* 1, Fig. 137. Then draw *C D* 9 inches from and parallel to *A B*; draw *E F*, and



extend this far enough to form a part of Fig. 137. From the center *G*, with a 9-inch radius, draw a semi-circle, and from *H*, Fig. 137, draw another semi-circle. Space off the four quadrants in these semi-circles into 6 points, and number them as shown; draw ordinates through these points at right angles to *C D*. Fig. 137 is complete, and that view is all that is necessary to lay out the tee piece. But as the opening and rivet holes are to be laid out in Fig. 139, at which the tee piece rivets, Fig. 136, will be required, and to complete that figure, the depth the ordinates encircle the lower cylinder must be secured. This is secured by drawing lines parallel to *C D* through the points where the different ordinates cut the semi-circles in Fig. 137; continue these lines to cut the similarly numbered ordinates in Fig. 136. Mark these points just found, 1, 2, 3, 4, etc. (If these lines cannot be projected or drawn through they must be secured by measurements.)

Now for the tee course, Fig. 138. This is 18 inches in diameter inside; $18 \times 3\frac{1}{7} = 56\frac{1}{2} + \frac{3}{16} = 56\frac{11}{16}$. Draw a line, and $56\frac{11}{16}$ inches apart draw lines for the straight seams at right angles to the first line drawn; space off the latter into 20 spaces or 21 points, draw lines through these points parallel to the straight seams. As the sides will require no flanging, the straight seam will be placed upon the side, consequently start with No. 1 at each end and at the center to number the lines, ending with No. 6 at each quarter. Measure the length of the ordinates No. 1 in either Fig. 137 or 136 (but preferably the former) between the line *E F* and where the diameter cuts the circle; this length mark upon the lines No. 1 in Fig. 138, measuring from the first line drawn in that figure. Then measure the length of the ordinate No. 2, Fig. 137, and mark it upon the



lines No. 2, Fig. 138, measuring from the first line drawn. Convey the lengths of the other ordinates in a similar manner, after which center these marks as a guide for flanging; allow 1 inch for flange; space off the straight seams, also the end for the required number of holes; allow the lap, and the sheet is finished.

Next comes the opening in the course of the pipe upon which the tee is riveted. This is 18 inches in diameter outside; $56\frac{1}{2} - \frac{3}{16} = 56\frac{5}{16}$. Lay out a sheet to make the course required, then draw a line *L M* lengthwise of the sheet at the point where the center of the tee is to be located; in this case it is midway of the length. (If this were a taper course, the only difference would be that the line *L M* would be curved to keep the same distance from the sides.) Notice in Fig. 137 this tee reaches down just to the center of the circle, consequently the opening will be one-half the circumference, or $28\frac{5}{32}$ inches in length. Draw a center line at the point the center of the tee is to be located. In this case the straight seam will be directly opposite, consequently this line will be one-half the circumference from the ends. Lay off on

* Foreman Boiler-maker, C., M. & St. P. Ry., Dubuque, Iowa.

the line $L\ M$ $28\frac{5}{32}$ inches, one-half on each side of the center line; space off this one-half into 11 points; draw lines through these points at right angles to $L\ M$; number them from 1 to 6, beginning with No. 1 at the outside and ending with No. 6 at the center. Set one point of the dividers at G, Fig. 136, and opening them to the point where the ordinate No. 6 cuts the line $C\ D$, mark this length upon the line No. 6, Fig. 139, on each side of and measuring from the line $L\ M$. Measure the distance from the center line to the point marked No. 5, Fig. 136, and mark this length upon the lines No. 5, Fig. 139, on each side of and measuring from $L\ M$. Convey the distances between the other ordinates in Fig. 136 in a similar manner to Fig. 139. For the rivet holes, in Fig. 132 was shown the distance the rivet holes were located from the back of the flange, which is $\frac{11}{16}$ inch. Consequently, draw a line for rivet holes $\frac{11}{16}$ inch outside of these points or marks; but notice this tee piece will not flange on the sides at all, so the $\frac{3}{16}$ inch radius will be lacking at the lower corner; and to make it come right, draw a line $\frac{11}{16}$ inch from the marks for quarter of the circumference, or to midway between the lines of division Nos. 3 and 4; then from there gradually reduce this distance down to ½ inch at the No. 1 point, space off this line for the required number of holes, draw a line ½ inch inside of the holes for lap, and the sheet is complete.

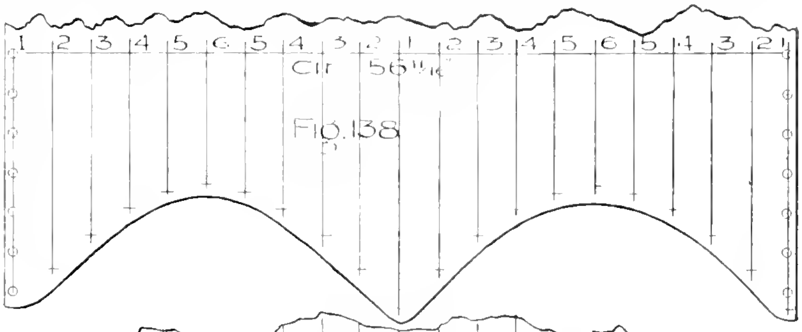


Fig. 138

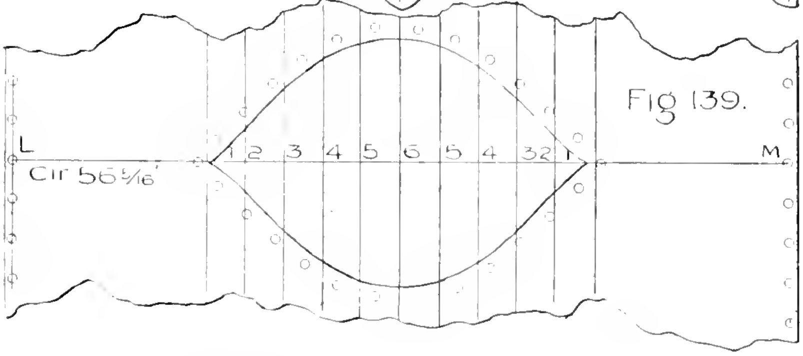


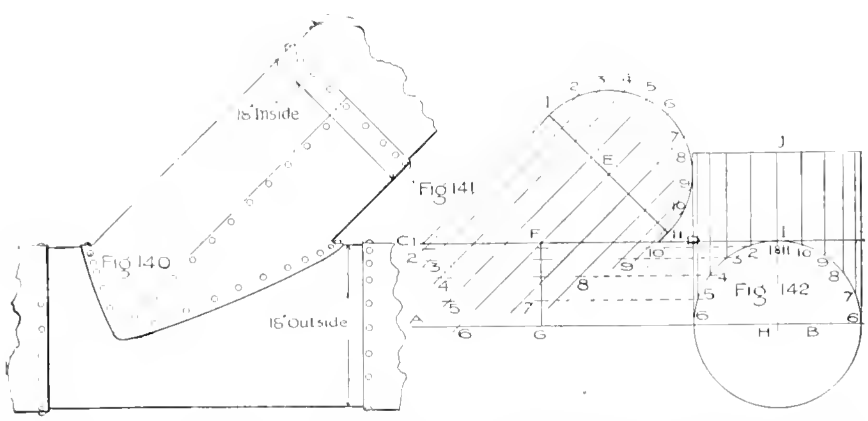
Fig. 139.

TWO CYLINDERS INTERSECTING AT OTHER THAN A RIGHT ANGLE.

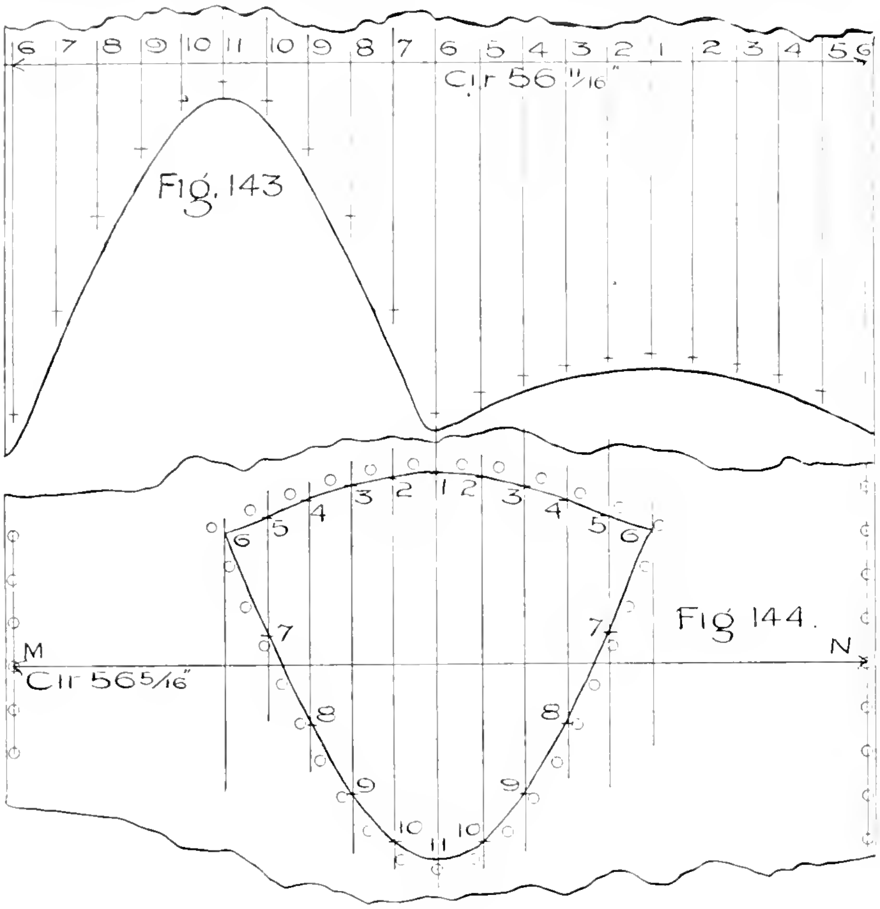
Fig. 140 is the side elevation of two cylinders intersecting at other than a right angle or forming an acute angle, acute meaning less and obtuse meaning greater than a right angle. It is immaterial what angle these cylinders occupy to each other, nor the difference, if any, in the diameters, only that the intersecting cylinder be the smaller. If the method given be followed, the pieces will come out O. K. Now for the outline views required to lay out the sheets.

Draw $A\ B$ and $C\ D$ parallel and 9 inches, the length of the radius, apart. Then $F\ G$ at right angles to $C\ D$. Through F draw the line 6 $F\ E$ 6 to the angle at which the cylinders intersect. Draw the diameter 1 E 11 at right angles to 6 $F\ E$ 6, and from E, with the dividers set to the radius, 9 inches, draw the semi-circle. And with the same radius from H as a center, draw the circle in Fig. 142 at any point upon the line $A\ B$ where it will not come in contact with the other figure. Draw the center line $H\ I\ J$ at right angles to $A\ B$, and from I draw a semi-circle. Space off the semi-circle, in each figure into 11 points. Draw ordinates through these points parallel to the center lines; and numbering them, start with No. 1 at the top in Fig. 141, and end with No. 11 on the opposite side. In Fig. 142, start with No. 1 at the top or highest part of the shell, and run down to No. 6 on the side; then start with No. 6 on the opposite side and end with No. 11 at the top. Mark the depth the ordinates encircle the cylinder in Fig. 141, by the same method used in Figs. 136 and 137, by drawing lines parallel to $C\ D$, cutting through the point where the ordinates cut the circle in Fig. 142. Now comes the sheet of which to form the tee piece. Draw a line along the length of the sheet, and $56\frac{11}{16}$ inches apart draw lines at right angles to the first, for the straight seams. Space off the first line drawn into 21 points, counting the straight seams; draw lines through these points parallel to the straight seams; number these lines, beginning with No. 6 at the straight seams, as they are to be located on the sides, 6, 7, 8, 9, 10, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 2, 3, 4, 5, 6. Measure the length of the ordinate No. 1, Fig. 141, between the line 1 E 11 and where it cuts the line $C\ D$. Mark this length upon the line No. 1 in Fig. 143, measuring from the first line drawn. Convey the lengths of all the other ordinates to the similarly numbered lines in Fig. 143; center-mark each of these points just found as a guide for flanging, allow one inch outside of these marks for the flange, space off the straight and other seams for the required number of holes. After which allow the necessary lap, and the sheet is complete.

Now for the course with the opening at which the tee piece rivets, Fig. 144. Lay out this sheet for a small, square course, using a circumference of $56\frac{5}{16}$ inches; draw a line $M\ N$ lengthwise of the sheet, the distance the center of the tee is to be located from the lines of holes along the side of the sheet and parallel to the same. Find the point on the circumference at which the center of the tee is located; in this case it is midway of the length or opposite the straight seam. From this point lay off one-half of the circumference, one-half on each side of the central point first found. As in this case the tee course is the same diameter as the main pipe, space off this length (one-half the circumference) into 11 points; draw lines through these points at right angles to $M\ N$. Number them as shown, starting with No. 1 at the center at one end, running to No. 6 on the sides, then from No. 6 on each side to No. 11 at the center at the other end. Measure the length of the line $C\ D$, Fig. 141, from $F\ G$ to where the ordinate No. 1 cuts $C\ D$. Mark this length upon the line No. 1, Fig. 144, measuring from the line $M\ N$. Measure the distance from $F\ G$ to the point marked No. 2 on ordinate No. 2, Fig. 141, below the line $C\ D$. Mark this length

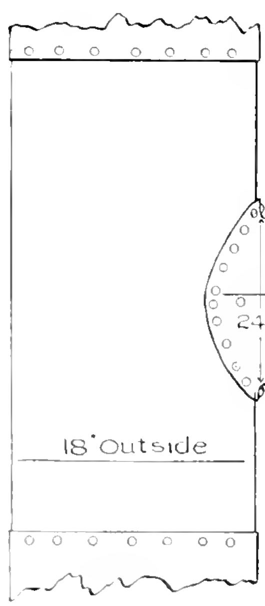


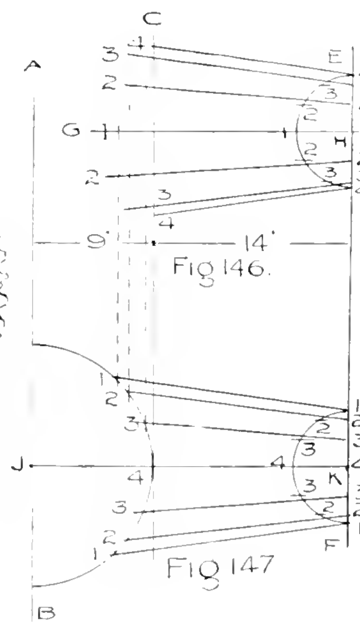
upon the lines No. 2 in Fig. 144, measuring from M N. Convey the other lengths in a similar manner until all are found in Fig. 144. Then draw a line outside of these marks for the rivet holes, $\frac{11}{16}$ inch from the marks, for one-fourth of the circumference, or to midway between the lines Nos. 3 and 4 and 8 and 9 on each side of the center line; then from there to No. 6 gradually reduce this to $\frac{1}{2}$ inch; space off this line for as many rivet holes as required. Draw a line $\frac{1}{2}$ inch inside of the rivet holes for lap, and the sheet is complete.



FRUSTUM OF A CONE INTERSECTING A CYLINDER AT RIGHT ANGLES.

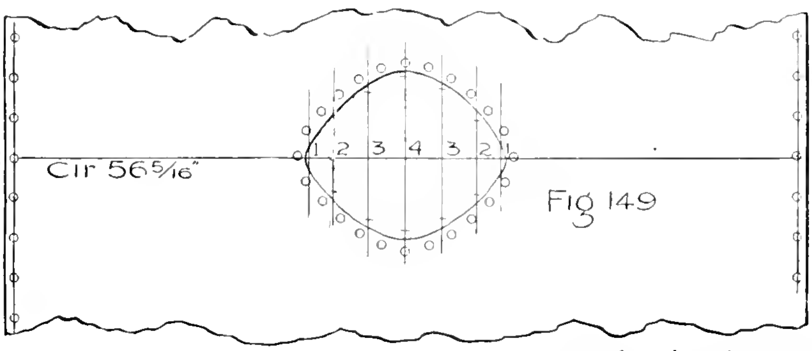
Fig. 145 is an elevation of a frustum of a cone intersecting a cylinder at right angles to their axes. Figs. 146 and 147 are the outline views necessary to lay out the sheets. Draw A B and C D parallel and 9 inches apart, then E F parallel and 14 inches, the height of the frustum, from C D. Next, the center lines G H I and J K L at right angles to A B. From H and K, with a radius of 6 inches, as the frustum is 12 inches in diameter at the top, draw the semi-circles, and from J, with a radius of 9 inches, draw the circle to represent the main pipe; mark off on the line C D, 12 inches each side of the center lines, for the diameter of the frustum at that point. Draw lines through the marks for the diameters on lines C D and E F, and they will cut each other at I and L. Space off both semi-circles into 7 points, number these points from 1 to 4; and in Fig. 146, beginning with No. 1 at the center, ending with No. 4 on each side. In Fig. 147, begin with No. 1 on each side and end with No. 4 in the center. Lay a square along the line E F, the blade to the points twos and threes successively, and mark these points upon the line E F. Then draw ordinates through these points, terminating at I and L. Again draw lines parallel to C D, to cut the ordinates in Fig. 146 through the points where the ordinates of the same number cut the circle in Fig. 147. This completes the Figs. 146 and 147. Now for the frustum, Fig. 148. Set the trams from I, Fig. 146, to where the ordinate No. 4 cuts the line E F. Upon the sheet of which the frustum is to be constructed, draw an arc with this radius, and, with a $\frac{1}{2}$-inch longer radius, draw another arc for the rivet holes. Now for the circumference; $12 \times 3\frac{1}{7} = 37\frac{5}{7} - \frac{3}{16} = 37\frac{7}{16}$. This length mark off upon the first arc drawn, and through these two points and the center draw lines for the straight seams; space off the arc into 13 points, and draw lines through them from the center. Number these lines, beginning at the straight seams with 1, 2, 3, 4, 3, 2, 1, 2, 3, 4, 3, 2, 1. Set one point of the trams at L, Fig. 147; the other where the ordinate No. 1 cuts the circle. Mark this length upon the radial lines No. 1 in Fig. 148, measuring from the center from which the arcs were drawn. Set the trams again from L to where the ordinate No. 2 cuts the circle in Fig. 147; mark this length upon the lines No. 2 in Fig. 148. For the ordinates Nos. 3 and 4, measure their length from I in Fig. 146 (as the proper length cannot be secured from Fig. 147, on account of the sides being at an angle). Convey these lengths to Fig. 148. Center-mark these points for flanging; allow the flange, the lap, and space off for the rivet holes required.

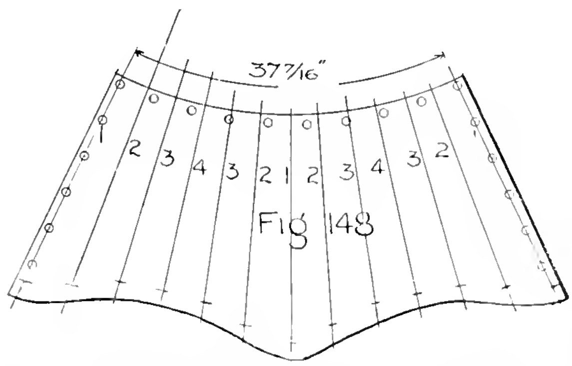




Next in order comes Fig. 149. This will also be a small course, 18 inches outside diameter, requiring a circumference of $56\frac{5}{16}$ inches. Draw the line R S where the center of the frustum is to be located. The circle, Fig. 147, is 18 inches in diameter; lay a strip of material (preferably something flexible, as a strap, for instance) just the same thickness as the material in the pipe, keeping it just up to but inside of the circle. Mark upon this strip the points where the ordinates cut the circle, numbering them same as the ordinate forming the point. Lay this strip upon Fig. 149, alongside of the line R S, with the No. 4 point

located where the center of the frustum is to be located; mark these points upon this line, numbering them same as on the strip; draw lines through these points at right angles to *R S*; measure the distance between the ordinates in Fig 146 where they cut the cylinder at and below





the line *C D*; draw a line for rivet holes $\frac{11}{16}$-inch outside of these marks. Space off this line for the holes, allow the necessary lap, and all is complete.

Engineer C. M. Church, of New Britain, Conn., had some experience last December with an engine that slipped when shut off. He is a careful man, and noted the phenomenon on several days consecutively. He was running on a three-mile branch, and says the tires threw fire and showed that there was a slip, but the movement of the crosshead proved that the engine was not slipping fast, as the jar and pound would lead one to think.

The Star Head-Light Company, of Rochester, N. Y., have issued two very complete illustrated catalogues of their head-lights and signal lamps, and lamps and lanterns, printed in Spanish for their Latin-American trade, which is growing very rapidly.

Conger's Questions and Answers, together with the Standard Rules of the M. C. B. and M. M. Associations, combined and illustrated, are now in book form. Price, 25 cents. Best aid book for enginemen.

The Central Railroad and Banking Company, of Georgia, after a test of the Sterlingworth steel I-beam body bolster, have ordered this device for 100 cars.

Additional Information on Air-Brake Handling—Examiner's Catechism.

By Clinton B. Conger.*

(Continued.)

Q. 46. How do you cut out the brake on engine and tender without disturbing train pipe?

A. By turning the four-way cock in top of plain triple so the handle is at an angle of 45 degrees; this will lap all ports and allow no air to pass from train pipe or auxiliary to brake cylinder; see that brake is entirely released first, and open bleeder in auxiliary.

Q. 47. Can you tell how the air is affected by the different positions of the brake-valve handle? Do so.

A. When brake valve is in "full release" the air can pass through open supply ports from main reservoir to train pipe, and through preliminary supply port and equalizing port to cavity over equalizing piston. When on "running position" the air from main reservoir is cut off from direct supply ports to train pipe, and must pass under excess-pressure valve to reach train pipe. The equalizing port is still open. When on "lap" all ports are covered so no air can pass from main reservoir, train pipe or equalizing reservoir to each other, or to atmosphere. When on "service application" the air goes from equalizing reservoir through preliminary exhaust, and from train pipe through train-pipe exhaust to the atmosphere; in "emergency" position the air in train pipe escapes to atmosphere through direct application port without lifting any valves.

Q. 48. What is the stop cock under brake valve for? Will it assist you in locating leaks? How?

A. To cut out the train pipe from brake valve when "double heading," so only one engineer can handle all the brakes. Yes, it will assist in locating leaks. When shut, after charging train pipe and auxiliaries, if there is a leak in train pipe, brake will set at once; if the rotary leaks either into or out of the train line, it will show it very soon, as there is so short a train line to leak into or out of. A little observation will teach you many ways of using this cut-out cock for testing for leaks.

Q. 49. Why must there be no leaks in your train pipes, or any other part of your air-brake supply?

A. If train pipe leaks, brake will continue to set tighter when brake valve is put on lap, and stop the train before you want it to, so that it is necessary to let it off and make another application for an ordinary stop. If cars are cut off from engine, they must be bled at once if their train pipe or angle cocks leak. Train pipes sometimes get worn through where they rest on or rub against something, so they are tight when standing still and leak when moving or shaken around. This sets the brake when train is in motion, and no leak can be heard when standing still.

Q. 50. Why must all hose couplings be hung up properly when not in use? Why should they always be blown out at rear of tender before uniting to other couplings? What is the difference between an air-brake and an air-signal coupling?

A. So no dirt or foreign matter will get into the open coupling and work into the triple or brake valve or stop up strainers. So couplings and gaskets will not get injured or broken dragging over rails and crossings. If blown out each time, any water, sand or dirt in the tender piping will be blown out. Air brake and air signal couplings are of different sizes—made so purposely—so the brake line cannot be coupled to the signal line. The opening and lip of the lock in brake coupling is much wider than the signal coupling so the brake coupling will not go into it. It is the practice to paint the signal couplings red so they are more easily distinguished when taking hold of them to couple up.

Q. 51. 1. After coupling to train, why should you not immediately try to apply the brakes for inspection? 2. How long should you wait? 3. Can an auxiliary reservoir be recharged without releasing the brake?

A. 1. Because you must wait till a full pressure of 70 pounds is stored in auxiliaries so a full application of brakes can be obtained to get the piston travel. 2. The time you should wait depends upon the pressure maintained in the train line from the moment of coupling on. If 70 pounds are held steadily, two and one-half minutes is the shortest time, but it must equalize in auxiliaries and train pipe at this pressure—even if it takes longer—before testing. When the governor stops the pump, with standard pressures shown on both hands, is generally time enough. 3. The ports are so located in the triple valve that the "feed port" through which auxiliary is charged does not open till after exhaust port is open; which releases the brake first, recharges afterward. By the use of a pressure-retaining valve, the auxiliary can be recharged without releasing the brake altogether.

Q. 52. Should the train brakes be inspected? How? When? Why?

A. Yes; by applying them with full service application, examining each car to see that the piston travel is the proper length and that there are no leaks that will let brakes off; then releasing and examining each car to see that all release, and that there are no leaks through exhaust port. They should be inspected at all terminals and tested whenever train breaks in two, or cars are taken on or set off, as the wrong angle cocks may be closed or left closed at such points. This is necessary, because it is not safe to depend on a brake till it is shown that it will set and release properly.

Q. 53. Would you consider a train safe to leave with, if the brakes had been tested by opening angle cock at rear of train, and how would this affect your main reservoir pressure?

A. No, sir; not unless some other test had been made. This would not set all the brakes unless the brake valve was on lap. It would draw down main reservoir pressure and waste air without doing any good. This test is only good to show that air hose are coupled, angle cocks open and train pipe charged from engine to last car.

Q. 54. What is the difference between the engine and tender triple valve and the

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car or quick-action triple valve? And why should not the engine triple do as well on a long train?

A. The plain triple sets slowly; when a long train of them is used it takes some seconds for the last triple to operate; the pressure in train pipe is reduced at the engine only. With a service application both kinds of triples operate alike. The "quick-action," in an emergency application, allows some of the air in the train pipe to escape at the triple (this air goes into its brake cylinder and sets this brake) so that the train-pipe pressure is suddenly reduced at each triple, and all the brakes on the train are set at nearly the same instant; thus there is less shock to the rear cars than with the plain triple, as the action of the triples travels from one to the other quicker than the shock can travel from car to car. The quick-action triple has two separate actions; in one a service application only operates the plain part of it, in the other plain and quick-action parts are operated at once. A quick-action triple is not needed on an engine or tender; as they are so close to the brake valve they operate quickly enough. None of the quick-action triples can be set to work straight air; some of the plain triples can.

Q. 55. If a quick-action triple should refuse to release, but kept blowing from the exhaust port with the brake on, what would be the matter and what would you do?

A. The emergency valve No. 10 was probably off its seat or was worn out and leaked bad. If out on the road and valve would not quit leaking, after a few applications, would cut out that brake.

Q. 56. If, while making a moderate service application, your brake would "fly on," and at the same time the air would stop running for a moment from train-pipe exhaust and then begin again, where would you look for the trouble?

A. In one of the quick-action triples. This action of the brake valve shows that one of the triples is working *quick-action only*, in advance of the rest, even with a service application. Probably the graduating pin is broken. Sometimes a triple with graduating spring gone will do this. It takes some skill to locate this defective triple. When you find it, cut it out.

Q. 57. Do you know what the "pressure-retaining" valve does? And how? If the pipe leading to this valve should break off, would you plug it? If you did, how would you affect the brake?

A. The pressure-retaining valve holds some of the compressed air in the brake cylinder after the triple valve has moved to exhaust position. It is attached to exhaust port of triple valve by a piece of pipe, and placed where it can be conveniently reached when train is in motion. When set to operate, its handle is turned up to a horizontal position, which closes the direct opening so the air goes out slowly under a weighted valve. When pressure falls to 15 pounds per square inch in brake cylinder, this valve shuts off the escape altogether and holds the air in there, keeping the brake set at 15 pounds; this allows the auxiliary reservoir to be recharged to full pressure again. It is used on long, steep grades. If the pipe was broken off and end plugged, brake would not let off at all, as there would be no way for air to get out of the triple exhaust. A steady leak at the "pressure retainer" comes from the triple, and turning the handle of the retainer will not stop the leak at the triple.

Q. 58. What is the difference between cutting the air out from a car and cutting it out from a brake?

A. Shutting the angle cock at the end next engine cuts out that car and all behind it; shutting the cock between the train pipe and triple cuts out that brake only, and allows all the rest to operate.

Q. 59. On a freight train, can you tell about how many cars are working air by the exhaust from train pipe in service application? Could you tell the difference if some of the cars were cut out? Is this important? Why?

A. It takes considerable practice to tell how many cars are coupled on. By this test it gives the number of car-lengths of train pipe in use; if the triple is cut out on any car it gives you no notice. When some of the cars are cut out by closing angle cocks, a less amount of air will come out than with all of them. Yes; it is important to know this, as some of the angle cocks may be closed, thus cutting off all the cars behind this closed one.

Q. 60. If you had a continual blow at the train-pipe exhaust port of the brake valve and could make no air, where would the difficulty be apt to be found?

A. Stuck or leaky piston *D-17*, dirt on valve seat, or bad leak in pipe to brake-valve reservoir. Would put valve on lap, then on emergency for a moment and see if that would stop it.

Q. 61. If you had *D-5* valve and the brake would not go on in service application, nor the black hand fall, or the service exhaust open, while air came readily from preliminary exhaust, what would be the matter?

A. I would look for a leak at the joint on lower gasket, where a leak would allow air to get from main reservoir direct to cavity over equalizing piston No. 47. This would give main reservoir pressure to black hand. A brake valve with this leak would show no excess pressure. No air could come out of service exhaust, as the pressure could not be reduced over the piston so valve could be raised. To set the brake, use direct application port.

Q. 62. Can you describe the position of the handles to all valves and cocks in the air brake and signal equipment, whether open or shut, and the reasons for same? Do so.

A. All the handles, except to angle cocks, stand at right angles or crosswise of the pipes when they are open, parallel to pipe when "cut out;" plain triples and pressure retainers follow the same rule, their handles are horizontal or crosswise when "cut in." The crooked handle of angle cock is parallel with pipe when cut in. This is so the hose will protect handle from being struck by anything flying under the car and getting shut off, as the old-style straight-handled cock is liable to. A small groove square across the end of plug shows whether cock is open or shut, as the groove runs same way with hole in plug.

Q. 63. If the pipe at one end of the car should come loose, would you consider it dangerous? Why?

A. Yes. If the pipe at the end of car gets loose so cock will bounce up and down and strike the handle end of plug against the deadwood or any part of car, it is likely to work shut gradually. This is caused by the spring which holds the plug in its seat turning plug a little each time it is struck. If the spring is wound one way, it works open; if the other way, it works shut.

Q. 64. In making a stop, how should you release the brakes on a freight train? On a passenger train?

A. On a freight train, after it has stopped, especially if it is part air. If brake is released on a freight train before train stops, and then slack runs out, train breaks in two, sometimes. If you work steam before slack runs out, train breaks in two, sure. With a passenger train, just a few feet before the train stops, so there will be just enough braking power to stop the train and avoid tilting the coach truck forward at the instant the train stops. Where brakes are hung from the body of the car the truck will not rock forward.

Q. 65. What would you do if an air hose burst? How would you know it? Should you have extra hose? Of what kinds?

A. Put brake valve on lap; whistle out a flag. If in a dangerous place to wait, or when a train is close behind, shut the first cock ahead of bursted hose; let off brakes on head end from engine; bleed the cars behind bursted hose; get to a safe place and replace the bursted hose with a new one. If with bad grades, or all-air train, put on a new hose, anyway. It would be known at once, because brake would set; main reservoir pressure would run down quickly; black hand would drop way down. Put brake valve on lap to save your air. To locate the bursted hose, put brake valve on running position, just so you will keep a little pressure in the hose and trainmen can hear the air blowing out of bursted hose and find it. Extra hose should be carried on engine, one of each kind used. Trainmen should have a 1-inch, a 1¼-inch, a signal hose, and one double-end orsplice coupling to use in case drawheads or couplings of cars are so long the regular hose and couplings will not meet each other.

Q. 66. Why is it necessary to use as little air out of the train pipe as possible when setting the brakes in service stop?

A. Because all that is used above the smallest amount necessary is wasted. If too much is used the brake will be set too tight, and must be released before stop is finally made at the proper place. On a long train, it may be impossible to release brakes quickly after the full stop, as the pressure cannot be raised high enough in the train pipe.

Q. 67. Of what use is the extra main reservoir pressure, and does the size of the reservoir have anything to do with the amount of excess pressure you carry?

A. It recharges the train pipe and forces the triple pistons up into exhaust position quicker and surer, so that all brakes release at about the same instant; recharges the auxiliaries to full pressure in less time, ready for the next application. With a large main reservoir there is a greater volume of compressed air stored to draw from, so a less number of pounds of excess pressure will do the work than with a small reservoir. With a short train, good work can be done with less excess than on a long train. The main reservoir should always be drained of water so it will be full-sized.

Q. 68. Could it release the brakes with an empty train pipe as readily as when the pressure in the train pipe had been reduced only 20 or 25 pounds? Why?

A. No. When the air from main reservoir expands into an empty train pipe, it will not fill it up and equalize at as high a pressure as when the train pipe has some pressure left in it. For instance, the train line of twenty-five freight cars holds about as many cubic inches of air as an ordinary main reservoir. If this train line is entirely empty and the main reservoir has 90 pounds, it will equalize into twice the space and show half the pressure, or 45 pounds in each. The brake would be set at 50 pounds; with that pressure above triple pistons, brakes could not release until the pump had raised the pressure over 5 pounds. Now, if the train line had been reduced 25 pounds, having 45 pounds still left in it, 90 in main reservoir and 45 in train line would equalize at a little over 65, which would raise triple pistons so brakes would release promptly.

Q. 69. Would you run your pump as

fast to recharge an empty train pipe as one with 45 or 50 pounds in it? Is there any economy in retaining as much air as possible and keeping the pump cool?

A. The pump would have to run faster to recharge an empty train pipe than one with 45 or 50 pounds in it. When you empty a train pipe of twenty-five cars, it wastes as much air as when you empty a small main reservoir; smaller trains in proportion. This would make some pumps hot to supply. Always save your air and keep the pump cool, no matter what length of train you handle.

Q. 70. Is it safe to try and retain air in a train pipe in the emergency application, and why not?

A. It is not safe, as a general rule. In an emergency, when life or property are in danger, you must act quickly. The point is to get *stopped dead* as soon as possible, and see about getting started afterwards. An emergency application is the last resort, and you *must* get it when you need it. If you do not let nearly all the air out of a long train pipe, some of the triples may not act quick enough. If three or four triples are cut out, or there are three or four plain triples close together at the head end of the train, the "quick-action" will not catch behind them, and all the air must be let out at head end of train to reduce the pressure as quickly as possible. Service application is too slow. With a full train of quick-action triples, a sudden reduction of 15 or 20 pounds at the engine will catch them all and leave considerable air in the the train pipe, so you can release and back up out of the other train's way if the brake stops you in time. This is the only special exception to the general rule. It is easy to hold part of the air when making tests or in the instruction car, but when you think some one is going to get killed, it is not quite so easy as "clear over" to "full emergency." Opinions vary on this question.

Q. 71. Does it require the same skill and judgment to stop a train properly as it does to get it under full headway by manipulating an engine?

A. Same kind of skill, acquired from practice. More judgment.

Q. 72. What is the difference between handling a train having part air in front and one entirely of air?

A. A great difference. It requires more skill and practice to make a good stop with a part-air train than with a full-air train. With part air you must be careful to "bunch the train" so slack will run up easily against the air-brake cars before setting the brake very tight; this takes some seconds. If you make a second reduction before the rear end feels the effects of the first one, the two light applications make one heavy one, as far as the shock to rear cars is concerned. When backing up, extra care must be taken or train will break in two and merchandise be damaged in cars.

Q. 73. If you were stopping at a water tank with part-air train with air brake set and with hand brakes set on rear cars, would you release the air brake and work steam in case you were stopping too quick? If you did, what would happen? Why?

A. No. If air brakes were released on head end, while hand brake is still set on rear end, the shock is sure to be severe. Air brakes should be held on until train stops or hand brakes let off. If you worked steam you would risk a break in two. Don't try it.

Q. 74. If you had a freight train with part-air cars in operation and you used the emergency application, would it make any difference whether the slack was out or not? In case there was a shock, on what part of the train would it fall?

A. Using the emergency brake with part-air train always sets the head end hard and solid; if slack is all run up against the engine the shock is not as great. In any case, the rear end gets all the damage; the weakest cars and draft gear behind air cars suffer.

Q. 75. Would you consider a car off the track at rear end of part-air train cause enough to use the emergency brake? Why not? Under what circumstances would you use the emergency brake?

A. Not always; unless it is one of the last cars in the train. Better keep the train stretched and make an easy stop; possibly the trucks would stay inside the rail and car bodies not telescope. This is a case no rule will fit; it depends on the good sense and quick reasoning of the engineer.

Q. 76. If in going around a curve you apply your brake to steady the train, where should you do it—on straight line or curve?

A. On straight line nearing point of curve, *every time*.

Q. 77. In applying your brakes, do you understand that the force with which you are retarding the train is exerted on the rail; that it is better to bring these strains lengthwise of the rail, as on a straight line, than crosswise, as on a curve?

A. Yes; it is better for the track, also for the train, as it may crowd some of the cars against the outside rail, hard enough to derail them. This may happen with air brakes ahead, empties in the middle and loads behind. Where brake beams are hung from the body of the car, it interferes with the curving of the truck if brake is set very hard on a curve—just *how much* no one can say positively.

Q. 78. In going down a long, steep grade, which would be the best practice, to make a number of applications or as few as possible, and keep your brakes on until compelled to recharge them? How would you control your train while brakes were released and recharging?

A. Air-braking on a long hill is a business to be learned on that particular hill; no set rule can be laid down. You must know just where the steep and the easy parts of the grade are located, so as to have a good pressure for the steep part of the grade and be ready to recharge on the easy part of the grade. Generally, you should make a moderately heavy application at first, and go as far as possible before making another one, or a third one. On a short hill this should hold the train till the bottom was reached. If on a long hill, make as few applications as possible between releases; use the "retainers;" try and pick out a place where the grade was easy, to recharge auxiliaries. "Hill work" is the most exacting of any operation of the brake.

Q. 79. If you release the brake and apply it again immediately, would you expect to obtain the same power you had before? How long would it take to regain the original pressure?

A. No, sir! *never*. About 40 seconds, if main reservoir had 35 or 40 pounds excess over auxiliaries, sometimes less time. The feed ports in triple valves, which regulate the time of charging, are not always the proper size for the reservoirs they supply. A short train and light application would reduce this time to 20 or 25 seconds. Generally it takes longer than the tests show it, with everything in good working order; the feed ports are not always clean and strainers free. The pressure at which auxiliary equalized after first application is what you begin with on second application after first release; generally it is 50 after first full application; with full release of brake and immediate application, you get 35 and a little more on second full application; the third time you will have less than 30 pounds piston pressure. Operating the brake this way is about as safe as opening the blow-off cock in boiler when the water is very low.

Q. 80. Does the difference in the travel of pistons in brake cylinders increase or decrease your braking power? Can the piston travel be correct and shoes be loose on the wheels? Why?

A. Long piston travel decreases the braking power, because it gives less air pressure on piston; short piston travel gives higher piston pressure. With 8-inch piston travel, 70 pounds auxiliary pressure gives 50 pounds on piston per square inch. An inch difference in the travel makes close to 2 pounds in pressure; thus, 7 inches would give nearly 52 pounds, 9 inches a little over 48 pounds. The piston travel can be correct with a heavy car and high leverage, and the shoes will not clear the wheel much when released. If levers and brake beams spring much with 8-inch travel, the shoes will not have much slack when let off. Brake levers may catch on something so piston travel is correct and shoes not touch the wheels.

Q. 81. What are "leakage grooves" for? Where are they? Is it necessary to allow for them when setting the brake? How do you do it?

A. Leakage grooves are small grooves cut in the inside of passenger, freight car, and some tender brake cylinders, at the top of cylinder, so that when piston is clear back in full release this groove is uncovered so that a small amount of air leaking by the triple, or from the joints, or from a *very* light application of the brake, will get past the piston and escape without moving it. They are long enough so a movement of the piston of 3 inches is necessary to cover it, after which no air can get by the piston. It is necessary to allow for them at the *first* application, by making it strong enough so piston will go far enough the first move to cover the "leakage groove." Five to 7 pounds reduction will do this, if everything is in good order; after that, 2 to 3 pounds reduction will set the brake tighter. If the hand brake is set on a passenger car or the piston travel shortened to less than 3 inches, that brake will not hold, as air will get by the piston through leakage groove. Driver brakes do not have leakage grooves.

Q. 82. What course would you take should your train break in two and set the brakes?

A. Shut off steam, put brake valve on lap, whistle out a flag, shut the open angle cock on rear end of last car connected to engine, let off brakes on head section from the engine. When they are let off, and you get a signal to do so, back up to rear section; after coupling up to it, if brakes cannot be let off from engine, bleed a few of the sticking ones at back end of train, until train can be started. Be very careful to shut the bleeder as soon as air begins to escape from triple exhaust port, or you will set some of the others, and that will hold the train longer than necessary. All air bled out is wasted; it is only done to save time.

Q. 83. If one brake beam under a car was broken, how would it affect that brake? How would you cut out the brake on that car and allow air to pass to other cars?

A. If one brake beam or rod is broken, the brake on that car is useless, and it must be cut out by shutting the cock in the "cross-over" from train pipe to triple, or by turning the four-way cock in plain triple. This will allow air to pass through train pipe to other cars without operating disabled brake.

Q. 84. Would it be safe to work your

driver brake on one side if the other side was broken? Why?

A. No. It would risk straining the engine if sand was used on free side of engine and none on the braked side. (Is it any worse than working steam with engine on "one side"?)

Q. 85. If there was an air signal on the engine that whistled each time you released the brake, what would be the trouble? If the whistle blows frequently when not in use, what is the matter? If it blows one long blast? If the whistle is weak on engine, will it usually help it to blow out the signal hose on the rear of tender?

A. If an air signal whistles each time brake is released with standard braking pressure, it is a sign the reducing valve is dirty and stuck open, so air goes back into main reservoir from signal line each time main reservoir pressure is reduced in recharging train. In this case, signal line has main reservoir pressure. Clean the reducing valve before the air-signal hose bursts. If the signal whistle blows frequently when not in use, there is a leak somewhere, which the jar of the engine may open for an instant, or a jar may unseat signal valve. Shut the cut-out cock at the reducing valve; if signal line leaks, it will whistle as soon as the leak can reduce the signal-line pressure. When it blows one long whistle, some of the valves on engine are stuck, or the car discharge valve is opened a second and third time before the whistle stops blowing the first blast; the pressure in signal line must equalize each time between the blasts to make it work accurately. If the whistle bell works loose so it does not make a clear sound, or is located near a partly open window so a strong draft of air blows across it when train is running fast, the sound will be very weak. Blowing out the signal hose at rear of tender gives all the valves a chance to make a full opening and clean out the dirt.

Q. 86. In backing a train, why is it dangerous for the rear brakeman to use the conductor's valve, or "backing whistle," to handle the brakes with—except in an emergency—instead of the engineer handling the brake?

A. If brake valve is on running position till brakeman sets the brake very easy, then put on lap; the stop is not very sudden. But where brake is set with emergency by brakeman at rear end, and released by engineer at the other, the shock to train is something serious.

Q. 87. Which engineer should handle the brake in "double heading," and what should the other engineer do?

A. The head engineer should handle the brakes in double heading. Second engineer should shut the cut-out cock under his brake valve, keep his pump running, and a full supply of air—brake valve on running position. If there is no cut-out cock, put brake valve on lap and plug the train-line exhaust elbow, so head engineer can release brake without losing air through your valve. When signaled to by first engineer, open cut-out cock and place valve in full release, shutting it again as soon as train is moving, so first engineer can stop the train at once if necessary.

Q. 88. Do you understand that all air cars in a train should be connected and train pipes charged with air, whether brakes are cut in or not? Why?

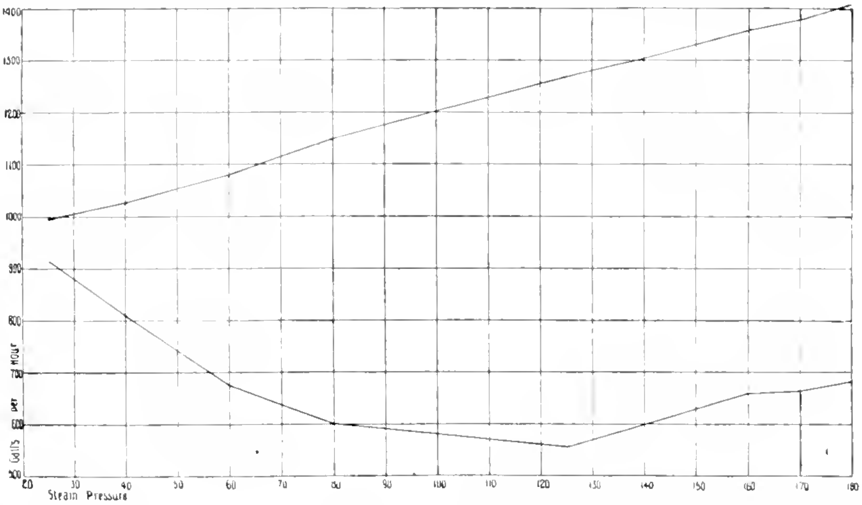
A. Yes; all train pipes should be coupled up and air working through them, so that if the train breaks in two anywhere in the line, all brakes will be set that are working.

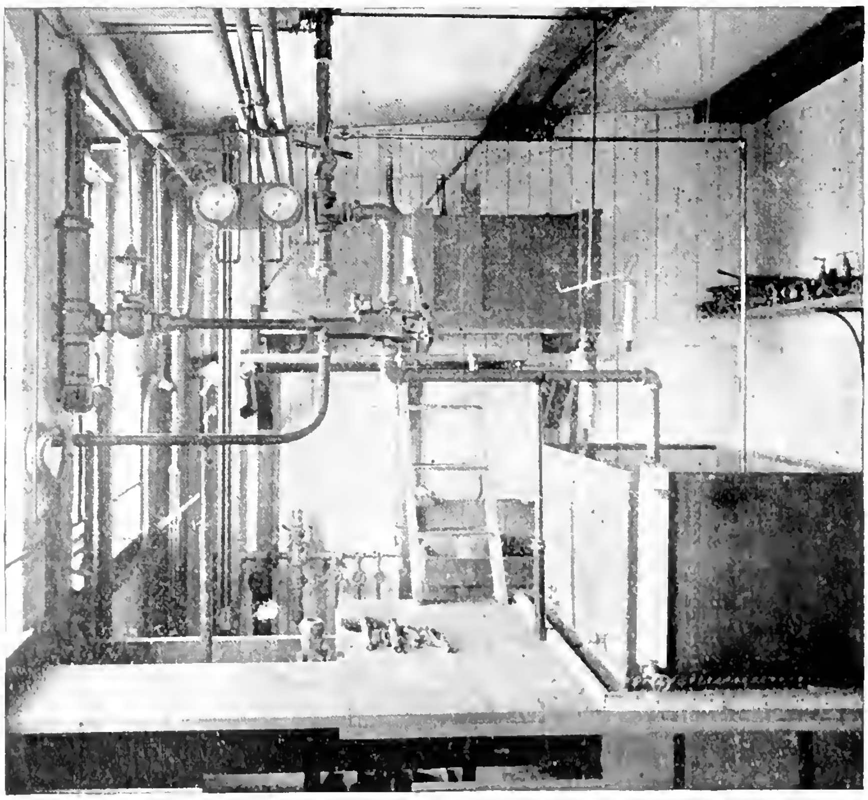
Q. 89. What should be done with a car on which the train pipe is broken?

A. If it cannot be plugged at leak and allow air to pass freely to cars behind it, it must be switched behind all other air cars; have air in hose that is coupled to next car in front; brakeman should look after this car and all behind it. If you have two ¾-inch air-brake hose the signal hose can be taken off signal line, brake hose put on, and signal line used for train line through that car to get air back to other cars.

Q. 90. Are you familiar with the air-brake and signal instructions as approved by the M. C. B. and Master Mechanics' Associations? What other books on air-brake instruction have you studied?

A. Yes, sir. Also Westinghouse Instruction Book.





Testing the Hancock Inspirator.

The annexed engraving shows a very complete and convenient testing room connected with the works of the Hancock Inspirator Company, Boston. The apparatus was designed by Mr. Park, superintendent of the works, and has enabled him to make very accurate tests of water-moving appliances. It is so designed that any range of lift can be arranged from the room, and any temperature of feed water required can readily be provided. The pressure at which the water is delivered can also be varied at the will of the operator.

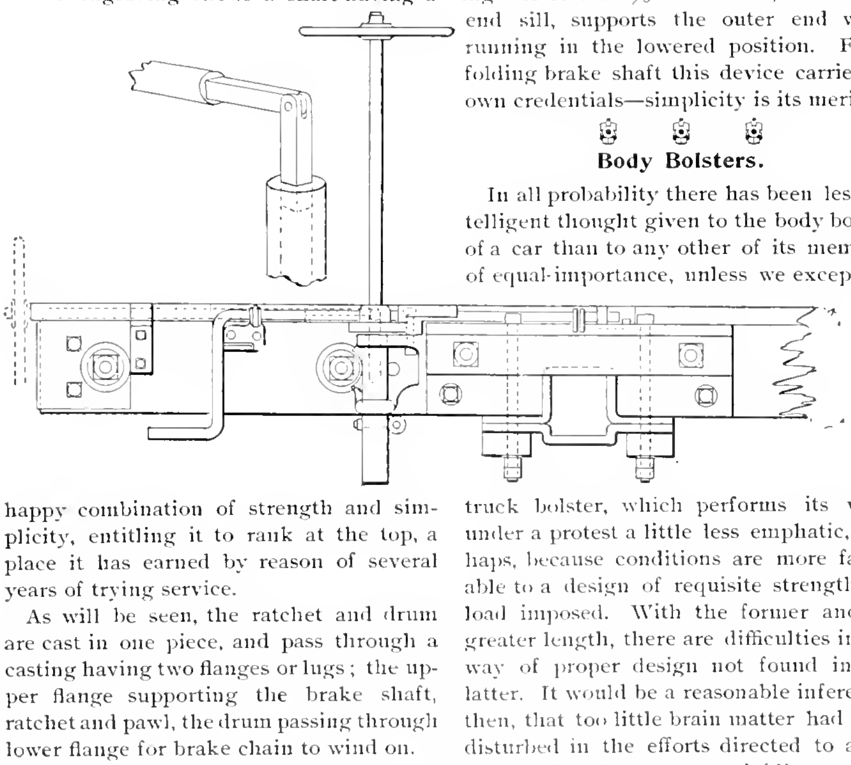
Above is a diagram showing the capacity of the Hancock inspirator as tested in the apparatus shown. It will be seen that the water-delivering range of the inspirator is remarkably wide. With 25 pounds pressure when working full, the capacity of the inspirator was 1,000 gallons an hour. As the steam pressure was increased, the capacity rose almost in a straight line until, at the maximum steam pressure of 180 pounds to the square inch, the capacity per hour was 1,400 gallons. The lower curve shows the action of the instrument when the feed was restricted to the lowest possible limit. The study of that curve will show that at one point the range between the lowest and highest capacity varied about 700 gallons per hour.

Conducted by Orville H. Reynolds, M. E.

Folding Brake Shaft.

The brake shaft that is capable of adjustment from a vertical to a horizontal plane, has long been an indispensable adjunct to a flat car. It must be made to lie below the top line of deck, so as to clear the load when necessary, and must also be a permanent fixture, so that, figuratively, its bones cannot be left to bleach on the right of way—a fate that has befallen many of its kind—after removal from the old-time cast socket to render loading easier, and then forgotten.

The engraving shows a shaft having a happy combination of strength and simplicity, entitling it to rank at the top, a place it has earned by reason of several years of trying service.



As will be seen, the ratchet and drum are cast in one piece, and pass through a casting having two flanges or lugs; the upper flange supporting the brake shaft, ratchet and pawl, the drum passing through lower flange for brake chain to wind on.

The casting is secured to end sill by one of the truss rods, for which the base of casting forms a washer. The brake shaft is forged square—1 inch—for a distance of 7 inches from the lower end, and fits in a square socket cored through the winding drum; an additional core, making a groove 3/8 inch wide and deep, runs from within 3/4 inch of top of socket to depth of 7 inches, forming a guide for the retaining pin, which is 1/4 inch diameter and passes through extreme lower end of brake shaft, projecting through each side and into the grooves 1/4 inch.

A hole is cored through the drum to enable this pin to be introduced, forming a lock that prevents the removal of the shaft from its socket under all conditions, yet allowing perfect freedom in raising or lowering.

When necessary to lower the shaft, it is lifted until the locking pin travels to upper end of groove, and then dropped to the horizontal position shown by dotted lines, the upper end of drum or collar on the ratchet being cast with a slot, which allows the shaft to lie below the top line of flooring. A rest of 3/8 x 2-in. iron, secured to end sill, supports the outer end when running in the lowered position. For a folding brake shaft this device carries its own credentials—simplicity is its merit.

Body Bolsters.

In all probability there has been less intelligent thought given to the body bolster of a car than to any other of its members of equal importance, unless we except the truck bolster, which performs its work under a protest a little less emphatic, perhaps, because conditions are more favorable to a design of requisite strength for load imposed. With the former and its greater length, there are difficulties in the way of proper design not found in the latter. It would be a reasonable inference, then, that too little brain matter had been disturbed in the efforts directed to a design having the necessary rigidity to hold the side bearings separated.

In fact, the past two or three years will cover the best attempts at a solution of the question, and they cannot be said to have reached a point that would justify a very long rest on the laurels earned.

Since the requirements are maximum strength and rigidity, combined with minimum weight and cost, the problem must be attacked from an entirely different standpoint than before; all guesses cease to have any value. A knowledge of the strength of materials and of the scientific aspects of the case must be had; and even equipped with these necessary weapons, all the conditions may be filled except that of weight, which might be such as to preclude its use by the progressive carbuilder who was alive to the importance of keeping dead weight as low as possible, something too frequently lost sight of; but there is an awakening in all quarters to this matter of dead weight, and it is a healthy sign.

Of the several types of bolsters in use, a few will be noticed and points of construction commented on, beginning with the old well-known wooden one, to illustrate the advance up to the present time.

This bolster was of oak, 5 x 14 in., trussed with two 1-in. rods connected with two 3/8 x 3-in. straps passing over top of center sills; the truss-rod nuts received in pockets at ends of the straps. This was regarded as coming very near to an ideal situation of things by the pioneers who were facing the issue of weak bolsters—for it seemed to show no inclination to ever betray the confidence of its sponsors. Overloading caused elongation of the rods, the wood went the way of all earth, and its usefulness was only a reminiscence. For its load of 40,000 lbs., the weight of this bolster was about 340 lbs., giving a sustaining power of about 75 lbs. of load per unit of weight, a ratio of capacity to weight not to be badly beaten by present practice.

An attempt was made to improve this bolster by the addition of two iron or steel plates, 1/2 to 3/4 in. thick, sandwiched vertically between the three wooden members; the whole secured by 3/8-in. bolts through wood and metal. The plates were used to insure against deflection when the truss rods stretched and let the side bearings together.

The plated construction was found to have a weakness in the shrinkage of the wooden members, leaving the bolts loose and the bolster in a condition wholly unfit to do its work.

This combination of plates and truss rods was stiff enough for the work when first put up and all was new, but the element of shrinkage sapped its strength at once, when the truss rods were called upon to carry the whole load. Being put up with the view of division of labor among all the parts, each member was made as

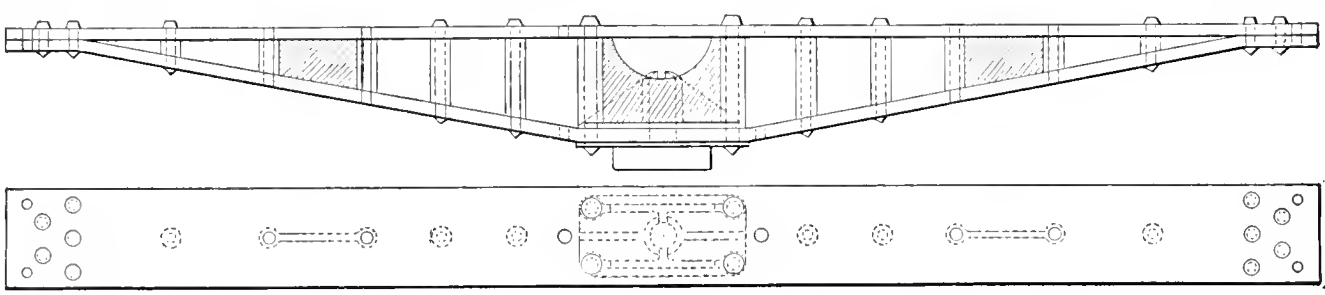
light as possible, on the principle of in union there is strength, and failure was the logical outcome when the bolts loosened up, proof that the union of wood and iron was not a happy one in a bolster, and incompatibility would go on the records as the ultimate cause of separation. Both of these had a common parent in the plain heavy block of oak which fulfilled its mission with 15,000-lb. loads, and was only trying to evolute into a bolster with strength to handle 40,000 and 60,000-lb. responsibilities.

A wooden bolster, 5 x 16 in., without the plates, and having three $1\frac{1}{4}$-in. truss rods, with ends enlarged to $1\frac{5}{8}$ in., will carry without deflection or elongation of the rods, a uniform load of 39,000 lbs.; this load (one-half of car body plus 30,000 lbs.), causing a tensile stress on the truss rods of 9,700 lbs. per square inch.; the rods being designed to carry the whole load, and regarding the wood as only a filler between sills and center plates, and as having no strength of its own with its share of the 60,000 lbs. load.

Such a bolster will weigh about 390 lbs. and carry 100 lbs. per unit of weight. The wood is the factor that shows up in the expense account.

The necessity for a purely metallic bolster began to be felt. Several designs were forthcoming, the most popular of which was two wrought-iron plates, the upper secured to under side of sills, and the lower one extending from the center plate to its junction with the upper member, at an angle depending on the distance that the plates were separated, the amount of separation being governed in turn by the available space between truck bolster and the under side of sills. The bottom plate taking the whole load, is in compression, and its value as a strut, it is seen, depends on the distance over bolster plates at the center—or, in other words, its angle—and the condition of its ends.

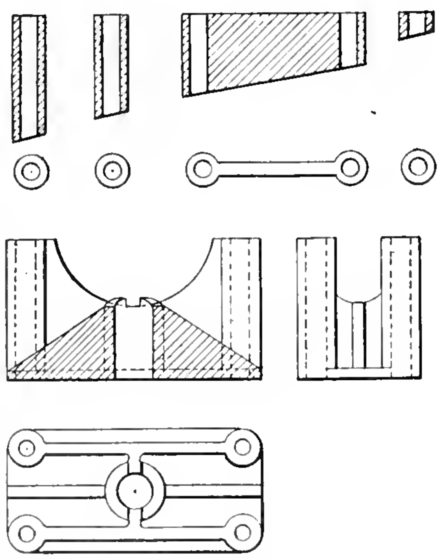
A bolster having but 6 in. over plates at center, and the usual $\frac{1}{16}$-in. play for the bolts, should not then be expected to keep the side bearings apart. The manner in which the ends are secured, as intimated above, is of the utmost importance in determining the stability of the bolster. The ends of the bottom plates in some instances abut against a shoulder formed on under side of the top plate, which is turned over and welded or riveted for this purpose. In other cases the thrust of the bottom plates is taken up by rivets alone.



If the former practice prevails, the plates should be a good fit against the shoulder, and if either bolts or rivets are used, they should *fill the holes.* A weak bolster is certain to result when these parts are not given the benefit of careful work in construction.

It is at once apparent that if a bolster of this type is to be introduced under a car that was designed for the wooden bolster just considered, that a very shallow bolster must be used, and one, therefore, without the required strength.

To build with an assurance of freedom from deflection, it must have an increased depth at center, and to get this increase the truck bolster must be lowered, which means that the truck transoms must also be dropped, and with them the arch bars, entailing an expense that will likely appal those handling the purse strings. We are obliged to face exactly the same conditions when trying to remodel the older and first of these iron bolsters into a design that will stand up under the load. The result of all this travail is that the truck is usually unmolested, and a bolster is made as deep as it is possible to get it, under the hampered conditions—truly a victim of environment. Any increase in strength is now had at the expense of dead weight, for the reason that it is impossible to distribute the material where it will do the most good.



To whom are we indebted for this legacy of grief and useless expense? The rule-of-thumb man, who thinks a guess is superior to calculation, is the one who has opened up for us this Pandora's box of weak-backed bolsters. Let us hope that his work is done—that we may know him no more.

The weak truck bolster should come in for its share of condemnation. It is often more at fault than its mate on the car-body for this going-down tendency. If there is $\frac{1}{8}$ in. deflection on each bolster at the side bearings, there is then $\frac{1}{4}$ in. of space taken up; this is usually the amount of space left for clearance at side bearings on freight equipment, therefore with a load the car is rigidly fixed at four points. There can be no defense for a weak truck bolster; no reason can be adduced why it should not be strong enough for any load, and not be excessively heavy.

Following in the lines of the all-metal bolster, somebody introduced a channel iron in place of the plain flat plate for the top member, leaving the lower plate substantially as in former construction, with an abiding faith that the flanges on the channel section would preserve it from the fate of its fellows.

There are no returns from this type as yet, but we shall hear from it as in all other cases, for there are no good reasons why the old weakness should not develop.

An evidence of the inventive bent crops out in the bolster made up of two I-beams, placed with webs perpendicular to underside of sills.

The originator found all too soon that the restricted space in old equipment made it impossible to use a section of sufficent depth to furnish the required rigidity. In new construction this can be provided for, but in any event it is open to the same objection with reference to deflection and weight. When the design will permit of a drop giving an increased depth of section, we can have a bolster on these lines that will not deflect, but we will also have one quite heavy. The reason for this is that we are dealing with a uniform section, and part of this section lying outside of the center of gravity of the load on the bolster has no serious bending moment to provide against, and is, therefore, useless to sustain the load, but must be paid for and hauled as dead load. There is reason to believe that it might be a paying investment to use a section of this kind, and remove the material not required by shearing. Save some dead weight here, and have a bolster both light and strong.

A new composite section has lately been evolved, proving that the sun of the car department "do move."

This bolster is also made of an I-beam, but placed with its flanges perpendicular to the under side of sills, and having a wooden filler between flanges at either side of web, whose thickness is equal to the height of flanges. This is entirely new and original and deserves success, if for no other reason than to encourage others to do a little exploring in virgin mechanical fields. It is said to hold up nicely and cost little for maintenance. The weight is about 600 lbs., a capacity of 65 lbs. per lb. of bolster.

A cast-steel body bolster has been proposed, and the proposition seemed to meet with favor from some who were afflicted with the limber variety and were anxious to be delivered from its thraldom at any reasonable cost. There is no doubt that some good things can be said of such a bolster. It could be cast on correct lines, putting the metal where it belongs, and, if made of box section, would be comparatively light. One of the things not so good that can be said of it is, that in case of a wreck, it is likely to be transformed to scrap, and the price of cast-steel scrap is way down.

Built-up sections of iron or steel plates have also been considered in connection with improvements of the body bolster. One of these has a box section formed by riveting the plates to channels and bracing to resist distortion. Like the cast bolster, this combined section can be made quite efficient, and also keep down the dead weight; but unlike the above, it is not hopelessly ruined in a smash, for it is only necessary to remove the rivets, restore the parts to their original lines, and rivet up again, when it is as good as before. This type has not as yet passed the sketch stage, as far as known, but probably will do so soon.

The continued use of the wooden bolster with truss rods, by such roads as the Pennsylvania and the New York Central, after a trial of metallic types, would point to the adoption of the former as the "survival of the fittest," as far as their investigations have extended.

The bolster absolutely free from deflection will not be built. A too strict definition of the word deflection leads to a race after the unattainable, for the reason that deformation is ever present, and will occur with the application of ever one pound of load. This cannot be measured with a two-foot rule, but the change in shape is there. Since a rigid interpretation is impossible, what would be a rational allowable limit of space at the side bearings, the point where excessive deflection is felt?

If the space here is $\frac{1}{4}$ in., it would seem that one-fourth of this amount, or $\frac{1}{16}$ in. could be considered good practice, as $\frac{3}{16}$-in. clearance would be had, providing the truck bolster stood up. In case the latter went down $\frac{1}{16}$ in. also, there would still be $\frac{1}{8}$ in. between bearings—ample space to avoid mischief.

Returning to the plated type of bolster, the engraving shows one seen in service on a 36-ft. 60,000-lb. box car. The weight of car body, 18,300 lbs.; the total uniform load borne by one bolster was

$$\frac{60,000 + 18,300}{2} = 39,150 \text{ lbs.}$$

It is seen that no puny construction will do in this case, and the two-plate type had been selected to work out the design as shown. First, a light casting was introduced at the center between the plates to prevent distortion at that point. Second, the plates securely riveted together with rivets that filled the holes; the theory worked on being, that if the centers could be prevented from moving together and the ends from sliding on each other, the lower plate would do its work perfectly as a strut, and therefore hold the ends up to position. The bolster was tested on a hydrostatic machine, and the appended figures tell how nearly expectations were realized:

Distributed Load.	Deflection at Side Bearings.
27,700 lbs.	0.016 in.
32,540 "	0.030 "
37,300 "	0.049 "
40,000 "	0.057 "
42,000 "	0.065 "
46,800 "	0.080 "
51,600 "	0.098 "
56,400 "	0.128 "

With a load of 40,000 lbs. (a few more pounds than its rate) this bolster shows a deflection of .057 in.—less than $\frac{1}{16}$ in., our proposed limit. The weight of 550 lbs. gives a capacity of about 72 lbs. per lb. of bolster.

The bolster weak enough to allow the load to ride on the side bearings, is directly responsible for the harvest of thin wheel flanges, greater expenditure of fuel to overcome increased resistance on curves, together with the unnecessary strains on body and trucks, besides being a constant menace to curves and tangents alike. There is no doubt that many a mysterious case of rails spreading could be traced to this cause.

Mr. Alexander Siemens, in a lecture at the Institute of Junior Engineers, explained to young engineers and inventors "How to Approach a Mechanical Problem." The advice is so pertinent and so capable of wide application, it is herewith presented, in the belief that it will have an educational value to some people who are full of the inventive afflatus, but not so well equipped with the necessary knowledge of the science of design.

1st. "Define as accurately as possible the want that exists or the particular object to be attained."

2nd. "Be well acquainted with the scientific principles which come into play."

3rd. "Know how the want is met, or the object attained in practical life."

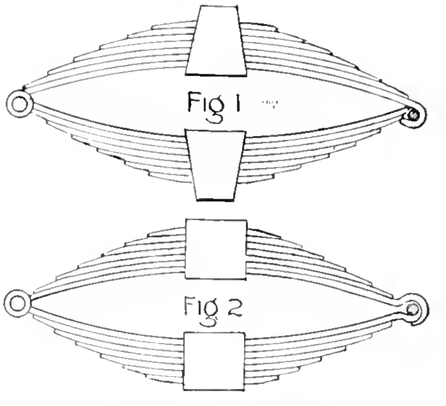
4th. "Find out what proposals have been made by others in similar cases."

These are words of wisdom. The first clause is always easy, but the second is the poser—the rock on which so many pet schemes are stranded. Without the third, theory would be helpless. Close attention to the fourth would often save valuable time, and would be useful in helping to avoid pitfalls reached by others in the same line of investigation. Had Mr. Siemens told the young gentlemen how to approach the bolster problem, he could scarcely have said anything more to the point.

Improvements in Elliptic Springs.

Seven years ago the A. French Spring Company, Pittsburgh, sent out a few elliptic springs with V-shaped bands, the invention of Mr. George W. Morris, general manager of the company. The improvement became popular quickly. Within the last six years close on 10,000 of these springs have been put into service on locomotives and tenders, and only 4 per cent. have failed to come up to the guarantee of one year's service.

The V-shaped band produces an equalization of pressure on all the plates and relieves the well-known tendency of the rectangular band to cramp the short plates, which causes breakage. The reduction of



band area on the short plates imparts increased deflection to the springs, makes a much easier riding engine and increases the durability of the springs.

That the theory of increased deflection due to the use of the V-band is correct was proven by numerous accurate tests of both half-elliptic and full-elliptic springs of both kinds. Standard-sized springs with the V-band of the same set and volume showed about $\frac{1}{4}$ in. more deflection than springs with rectangular bands.

The same conditions were secured in the full-elliptic springs shown in Figs. 1 and 2. The springs with the V-band maintained the same proportion of elasticity over the others.

In connection with the springs shown there is another valuable improvement in the ends designed by Mr. P. N. French.

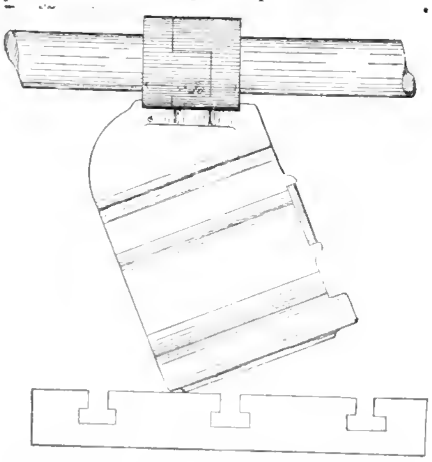
The practice heretofore has been to form scrolls at the ends of the main plates, the scroll on the under main plate being inclosed in scrolls on the upper plate. These scrolls, as is well known, are formed by a reverse curve from the general curvature of the main plate, so that they form an abrupt shoulder at the ends of the main plates. Hence it is necessary to make the

second plate considerably shorter than the main plates. This construction is objectionable for the reason that portions of the main leaves are unsupported by the second plates, and it is also objectionable on account of the injury to the structure of the steel due to the formation of the reverse curves in shaping the scrolls at the ends of the main plates.

These objections have been overcome in the design of the elliptic spring as presented and illustrated in the accompanying cuts, by constructing the ends of the main plates so that the second plates may overlap nearly the whole of the main plates, or at least project beyond the bearing points on which the main plates rest when in operation, as the fastening of the upper and lower halves of the spring is provided for without using the objectionable reverse curve scrolls, leaving the structure of the steel intact. It is well known that a major portion of broken elliptic springs break at the scrolls. Both the driving and duplicate springs are not recommended for new specifications, as the set of the driving spring is excessive. The use of 4-in. or wider steel in the duplicate springs is desirable, the foregoing springs being exaggerated in dimensions to better illustrate the strong point claimed under the most adverse circumstances.

Great Northern Railway Shops.

The Great Northern shops at St. Paul, like many another that can count its years of usefulness by the score, sometimes finds itself yearning for a machine tool on which to do certain work cheaper, or to expedite the output. Like all other well-regulated shops, it proceeds at once



to the root of the case, and designs something to fill the want.

It was decided that oil boxes for cars and tenders could have the faces for the covers dressed to size on a milling machine quicker and better than by the old method of planing, but the decision came easier than the machine to do the work.

Mr. George Dickson, the general foreman, had a large horizontal boring machine that was not in commission at all times, and he concluded that it would do a good job of milling if put in proper shape for the work. He first put on a cross-feed for the table, on mechanical lines and in keeping with the general good work on the tool—no makeshift rig for to-day and under the bench to-morrow—but a permanent fixture.

To the boring bar he fitted a milling cutter, got up in the form of a clutch, in two pieces that can slide on the bar or arbor, to or from each other, to the limit of length of the lugs, thus increasing or diminishing the width of cut. It is shown closed in the engraving; when used for wider work, the halves are held apart by liners, the whole held by nuts at the ends in usual way.

This transformation from a borer to a miller tells of a healthy mental tone, bringing into new uses a tool that had too many holidays.

They have a way of prolonging the life of wash-out plugs that Mr. Dickson says is a good thing. The holes are flanged as shown in the engraving, giving an increased threaded surface, from the usual $\frac{1}{2}$-inch to about $\frac{7}{8}$-inch. A plug can be taken out and returned any number of times with the certainty of being tight.

A "Safety" for Railroads.

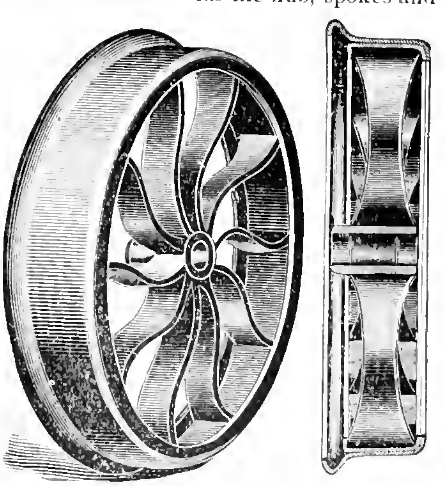
One of the neatest inspection cars imaginable is shown in our engraving. This is a bicycle, pure and simple, with a side-arm attachment to permit it to be used on a railroad track. This machine is so light that one man can pick it up and carry it anywhere. When folded, as shown, it only occupies 18 inches wide and 6 feet long, and can be carried in a caboose or baggage car as easily as an ordinary bicycle. The frame is made of steel tubing, the connections of drop forgings; it has ball bearings and tangent spoke wheels; the usual parts nickeled in a bicycle are the same in this. Wheel rims are made of No. 16 gage tire steel beaded outwardly at outer edge, and in at the center, to give the greatest strength possible. The front and small auxiliary wheels both have reinforced rail flanges made to M. C. B. standard. The flange of 24-inch forward wheel can be adjusted with the handle bars by the operator, to run toward or from the rail, thereby making it possible to pass around the sharpest curves and over imperfect or worn frog points at a high rate of speed without danger. Also, when running over straight track the operator can adjust forward wheel so that the flange will run free from the rail, and thus avoid any unnecessary friction. The rear wheel has no rail flange—it being in line with the forward wheel—the frame very rigid and the tread sufficiently wide to make derailment impossible. The auxiliary wheel is 11 inches diameter, has a rail flange, and is otherwise constructed throughout same as larger wheels. All three wheels are covered on the tread with a continuous rubber band $\frac{3}{16}$ inch thick by 3 inches wide. These rubber tires adhere closely to the rail, thus

doing away with all danger of slipping and car jumping the track when the rails are wet or frosty. They also cause the car to run noiselessly, thus enabling the operator to detect approaching trains from the rear as well as the front. They also take the jar from the machine, which adds a large percentage to the life of the same.

The new railway velocipede can be propelled at the rate of 20 miles or more per hour on level track. Weight without second man attachment (not shown), 55 lbs.; with attachment, 60 lbs. These machines are made by the Kalamazoo R.R. Velocipede & Car Co., Kalamazoo, Mich.

A New Hand-Car Wheel.

The Kalamazoo R.R. Velocipede & Car Co. have, after a year's trial, adopted a standard wheel, as shown in our illustration. This wheel has the hub, spokes and



rim in one malleable casting, and the steel tire is shrunk on. This tire is without a weld, spun from a solid steel washer. This wheel is easily re-tired without tools; there is not a bolt, nut or rivet about it. The centers are practically permanent investments, and new tires are cheap.

The Restauro Manufacturing Co., of Cortlandt street, New York, have put upon the market a substance called "Restauro," which is highly recommended for taking stains of all kinds out of cloth. Some of the railroad companies are using it for cleaning plush of car seats, and it makes old material look as clean and fresh as new.

Improvements in Baker Heaters.

On the top of the factory at Hoboken, N. J., used by Mr. William C. Baker in the manufacture of his well-known car-heating apparatus, they have erected during the past winter the body of a passenger car for the purpose of experimenting with the different arrangements of car heating.

Besides an entirely new form of car heater, one of the principal novelties actually in use is a heat storage cylinder, of the size of a compressed gas tank, and suspended in a like manner. This is nearly filled with pebbles, through which steam, at a high pressure, is ejected from a stationary boiler, and the heat fed equably through the car, as required. Mr. Baker has tested this new arrangement the past two winters on street cars, and, with changes thereby taught and suggested, he is confident that this arrangement will keep the largest passenger car comfortable, without any further attention whatever; and this desired object can be attained with the entire elimination of all fire, and of all steam and its appliances within, without, or in any way attached to the car, for a thirty or forty-hour trip, or the time of railroad travel between any of our large cities.

Railroad men interested in car heating would find a visit to the Baker factory very interesting, and the practical appliances used for making tests would give them information in a few hours concerning car heating that they could not acquire otherwise in years of desultory study of the subject.

The factory itself is well worthy a visit on account of the perfected appliances used in the manufacture of heaters. Every operation in finishing material is done by special tools that secure accuracy and reduce the labor to its lowest limits. Most of the heaters to be seen in the shop are made of steel shells, the outside and inside parts being welded together—the welding is done by electricity and makes a perfectly homogeneous job.

Mr. Baker has lately perfected a new form of heater, which he expects to put on the market for next winter's use. As a practical test of its durability, he has put a group of the new apparatus together and is using them to generate steam for running the engine of his factory. They give wonderfully high evaporation of water to the fuel used, and the probability is that the device may become popular as a safety boiler for the generation of steam for industrial purposes.

The Pedrick & Ayer Co., of Philadelphia, report that they have had more inquiries and sales of their special tools during the last month than they have had since the depression of business came on.

Air-brake schools are being formed by the men at many shops.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(51) C. H. P., Spokane Falls, Wash., writes:

Will you kindly advise us the date fixed by Congress when safety appliances such as air brakes, automatic couplers, grab irons, etc., shall be placed on railroad equipment? *A.*—January 1, 1898.

(52) A. J. D., Whiting, Ind., writes:

1. How is one to find the forward and back eccentrics? *A.*—The straps of the forward eccentric are generally connected with the top of the link. 2. How would it affect the exhaust or valve if eccentric strap bolts should become loose? *A.*—The exhaust would become irregular.

(53) G. W. O., Junction, N. J., writes:

What is a relief valve placed on a steam chest for, and where does the relief come in? *A.*—During a certain part of the stroke, when running without steam, the piston draws in air to fill the cylinder. The relief valve on the steam chest is designed to enable the piston to draw in the air required. It is very desirable that this need for air should be satisfied.

(54) T. F. W., Altoona, Wis., asks:

If an eight-wheel engine breaks off a front tire, and wheel center is swung clear of rail by blocking up over pedestal brace, and block put under forward end of equalizer instead of taking spring out over broken wheel, is it safe to run in with main rod connected up to broken wheel? If not, why not? *A.*—We cannot see why it would not be safe to run in this way—it is done often and successfully.

(55) T. H., Wickham, N. S., writes:

1. What sort, and how constructed, is a Laird guide? *A.*—It is a double-bar guide with the crosshead pin beneath the lower bar. 2. Is there any engine in the back numbers of LOCOMOTIVE ENGINEERING showing this guide? *A.*—The Central Pacific twelve-wheel locomotive, shown as a frontispiece to our March number, has this guide. 3. What happens when an over-cylindered locomotive is pulling hard? *A.*—The wheels slip.

(56) G. W. R., McAdam Junction, N. B., writes:

We have had an argument here about right-hand and left-hand firing. One side says that a fireman standing with his back to the driver and throwing coal into the firebox in this position is left-handed, the other side claims he is working right-handed. It was decided to refer the question to you. *A.*—The fireman is considered to be firing right-handed when the right hand grasps the lower part of the shovel handle.

(57) S. C. E., Phillipsburg, N. J., writes:

Some of our engineers say that there is no emergency brake on engine or tender. If this is so, how are there emergency brakes on the cars? *A.*—The emergency brake, as you call it, depends upon the kind of triple valve used. If the quick-action triple valve is used on the tender, it will operate on emergency application just the same as the brakes on the cars. Some tenders do not have the quick-action triple valve. In that case the brake is slower in being applied.

(58) J. H. H., Burbank, Cal., writes:

In March issue of LOCOMOTIVE ENGINEERING you say, in answer to question 43, that if an eccentric is put in the lathe and turned down ½ in. there will be no change in the throw. It appears to me that as the throw of an eccentric is equal to the diameter of the circle described by the outer edge of the thick side at each revolution of the axle, that to turn it down ½ in. would diminish the throw 1 in. *A.*—You are wrong. The throw of an eccentric is equal to the distance between the center of the disk forming the eccentric and the center round which it revolves. Take a circular piece of paper and mark a true center upon it. Then 2½ in. to one side of that center make a mark and stick a pin through the point. It will be found that in turning the disk round the pin the thick side has a variable motion of 5 in., or double the distance between the true center of the disk and the eccentric point round which you are revolving the disk. If you reduce the diameter of the disk ½ in. or more you will find that the difference between the travel of the thick and thin edges of the eccentric remains the same.

(59) F. K., New York, writes:

1. When wedge bolts are broken, how do you keep wedge in position? *A.*—Block above and below. 2. Which center is most convenient to set eccentrics from? *A.*—We have generally found the forward center most convenient. 3. Where do the eccentrics stand in relation to the crank pin on that side of the engine? *A.*—The thick part of the eccentric is above the axle, advanced toward the crank pin a distance representing movement equal to the lap and lead of the valve. The back eccentric is below the axle, advanced toward the crank pin the same distance as the forward eccentric. 4. Where do they come in relation to the eccentrics for the same motion on the other side? *A.*—If you are working from the right-hand side of the engine and the right crank leads, the eccentrics on the other side will be 90 degrees farther back. 5. When valve seat breaks, does it do any damage to other parts of the engine? *A.*—Very much damage, indeed, sometimes. 6.—How do you keep the packing rings out of the counter bore? *A.*—By preventing them from traveling over it. 7. Would you take out the cylinder cock at the end piston is in? *A.*—Yes.

(60) J. L., New Kamilche, Wash., writes:

While out of sand and on a slippery rail, recently, had some trouble in making a grade, not because she was cutting off at 9 inches, but on account of the rail. Made the grade at about ten miles an hour, but she slipped considerably. After making the grade, the vice-president, who was on the engine and is a mechanic, asked me why I did not drop her down and she would not have slipped so. He maintained that with the lever down and the throttle light would bring the train without slipping, as the pressure would be equal the full length of stroke instead of full pressure for 9 inches when hooked up. My argument was that she would slip longer when hooked up, as the steam in the chests and dry pipe would have to work out expansively. But otherwise the train weighed so much, and a power sufficient to bring that train out would have to be exerted, and it did not make any difference whether in the corner or hooked up, with the exception of slipping longer, when she did slip, if hooked up. Who is right? *A.*—The vice-president was right. When the steam is throttled and following the piston without early cut-off, the rotative effort is more uniform and therefore does not start slipping so readily.

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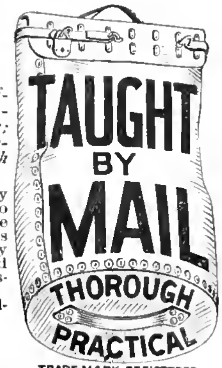

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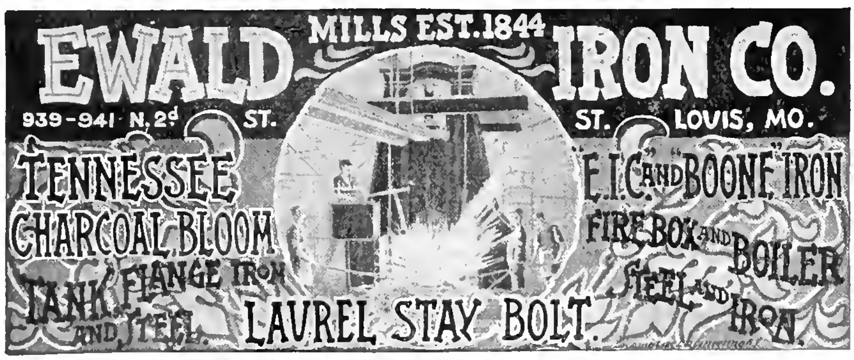

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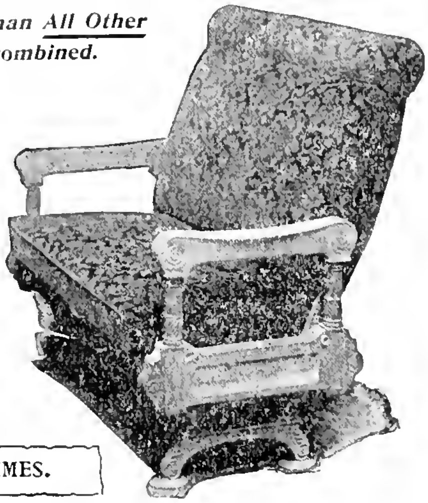

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Design and Erect

Locomotive Coaling Stations

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Coal and Ashes Handling Machinery,

Of Modern Design,

To meet any conditions.

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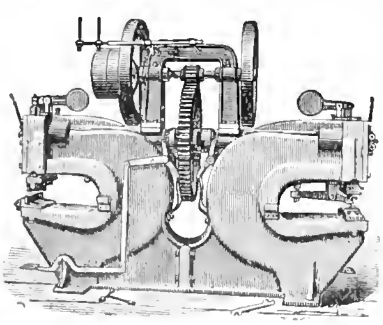

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Punches & Shears

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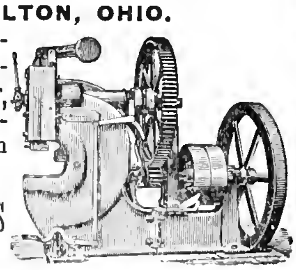

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TEN CENTS

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PREVIOUS TO JULY 1st, WE WILL MAIL ONE OF OUR

BEST TWO-INCH STEEL RULES

WITH ENDS HARDENED.

ONLY ONE RULE TO THE SAME ADDRESS.

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MANUFACTURERS OF

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SINGLE AND DOUBLE HEAD MILLING MACHINES used as Substitutes for Planers for Heavy and Rapid Cutting in Cast and Wrought Iron and Steel

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A SWEEPING RECORD!

Over Fifty Thousand Fires Kindled for less than

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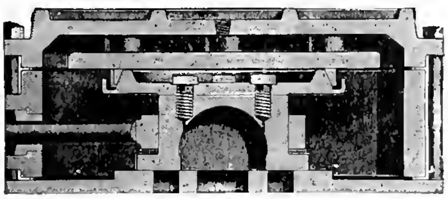
Records from six railroads, during the past twelve months, show that through the use of the LESLIE AUTOMATIC FIRE KINDLER the Cost of Kindling their Fires has not varied more than the smallest fraction of *a Cent per Fire*, month after month, and that *One Car Tank of 6,000 Gallons of Crude Oil* will *kindle more Fires* than *107 Car-Loads*, or *750 Cords, of Wood.*

For full particulars, address J. S. LESLIE, Paterson, N.J.



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Simple, Self-Supporting,
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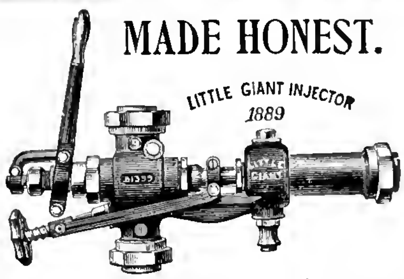
MADE HONEST.



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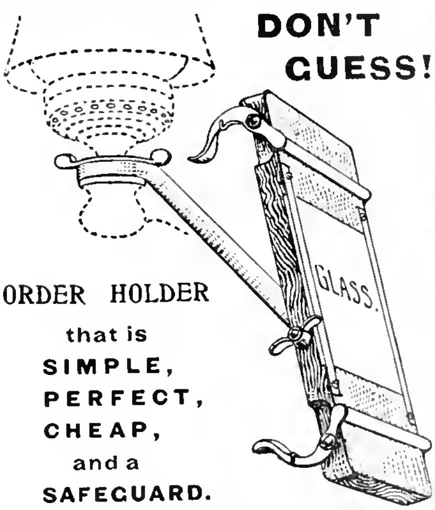

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SIMPLE,
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CHEAP,
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SAFEGUARD.

You live on your engine, have the best and safest tools.

FORGOTTEN ORDERS
have cost many lives—
Is yours worth
HALF A DAY'S PAY?

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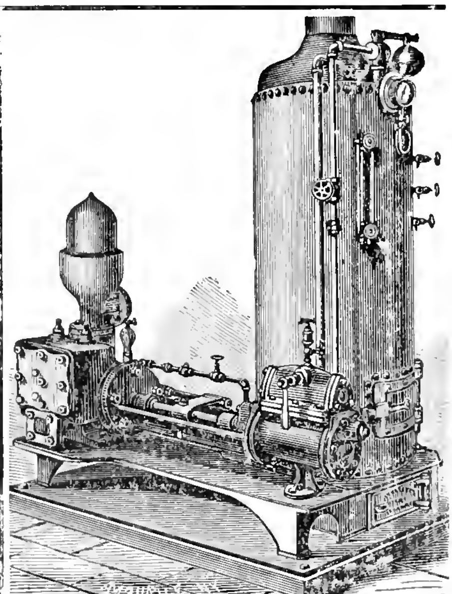

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Complete with Boiler.

THE A. S. CAMERON
Steam Pump Works,
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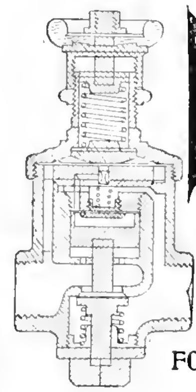

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STEAM OR AIR
NEWARK REGULATOR CO.
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FOR CAR HEATERS
HAS NO EQUAL.

Sent on approval to responsible parties.

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VALVOLINE OIL has long been used on many of the leading railroads in this country and abroad. It has no equal in quality and mileage.

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SAFETY, SPEED and ECONOMY are the results of the use of Galena Oils. COLD TEST, 10 to 15 BELOW ZERO. These oils do not freeze in the coldest weather, while they are adaptable to the hottest climates.

In the use of Galena Oils there is an entire freedom from hot boxes, except when these are caused by mechanical defects.

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We also furnish our customers SIBLEY'S PERFECTION VALVE OIL, which is also used exclusively upon a majority of the leading railways of America.

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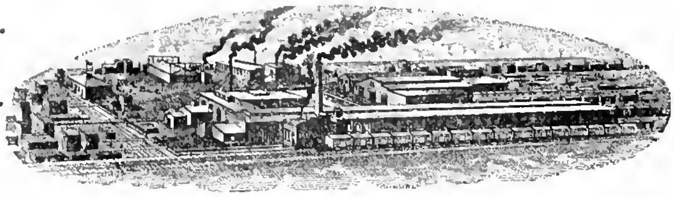

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Capacity, 15 Cars and 200 Car Wheels.

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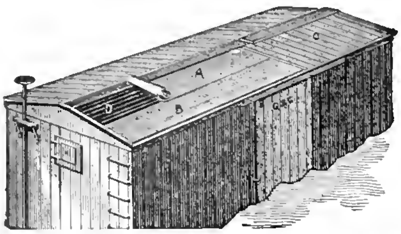

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THE COMING ROOF!

HEAVY, DURABLE AND STRONG.
WILL WEAR LONGER THAN ANY METAL ONE.

COSTS FROM $10 TO $15 LESS PER CAR.
CAN BE PUT ON IN ONE-HALF THE TIME.

WILL WEAR THE LIFE OF THE CAR.

HEAR WHAT THEY SAY ABOUT IT:
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LOCOMOTIVE CYLINDER LUBRICATOR.

EXTRACT FROM REPORT OF THE FRANKLIN INSTITUTE.

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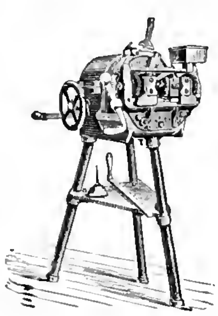
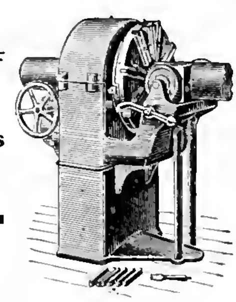


No. 1 Machine.



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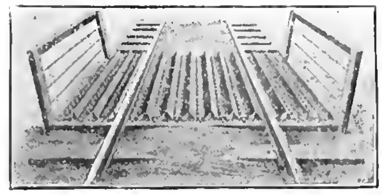
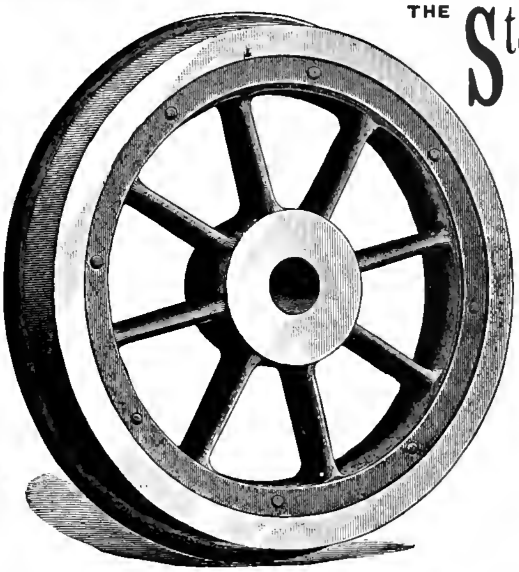
Specialties in Light Cars & Surface Cattle Guards.

CATALOGUE FREE IF YOU MENTION LOCOMOTIVE ENGINEERING.



WROUGHT IRON WHEEL CENTRES. VAUCLAIN'S PATENT.



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STEEL TIRES

Manufactured by an Improved Process Insuring Solidity.

Wrought Iron Centres.
Steel Tired Wheels.

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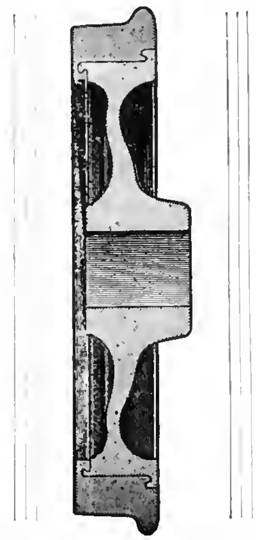

"HERE'S A WHEEL"

OF TWO PARTS,

A Wrought Iron Center,—a Steel Tire—and Nothing Else.

SAFETY.
DURABILITY.
ECONOMY.
THE RIGHT METAL IN THE RIGHT PLACE AND SHAPE

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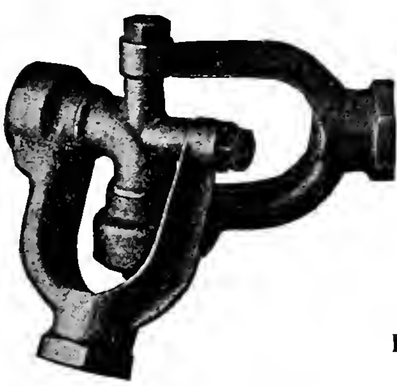
Chilled and Steel-Tired **WHEELS** A. Whitney & Sons, ESTABLISHED 1847. PHILADELPHIA.

Made with Special Reference to use under Engines and Passenger Cars.



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Flexible Steam Joint

Does away entirely
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HAS NO GROUND JOINTS.

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IN COMPLETENESS OF EQUIPMENT.
COMFORT OF TRANSPORT.
PROMPTNESS OF SERVICE.
FAST AND ELEGANT TRAINS.

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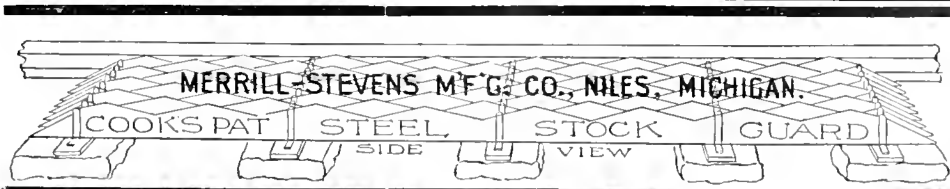

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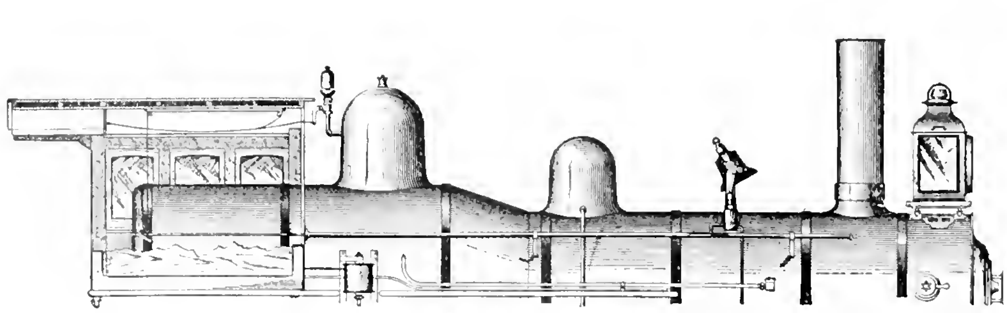
It's explained in our little book.

Book costs a postal.

Guards might Save your Company Money.



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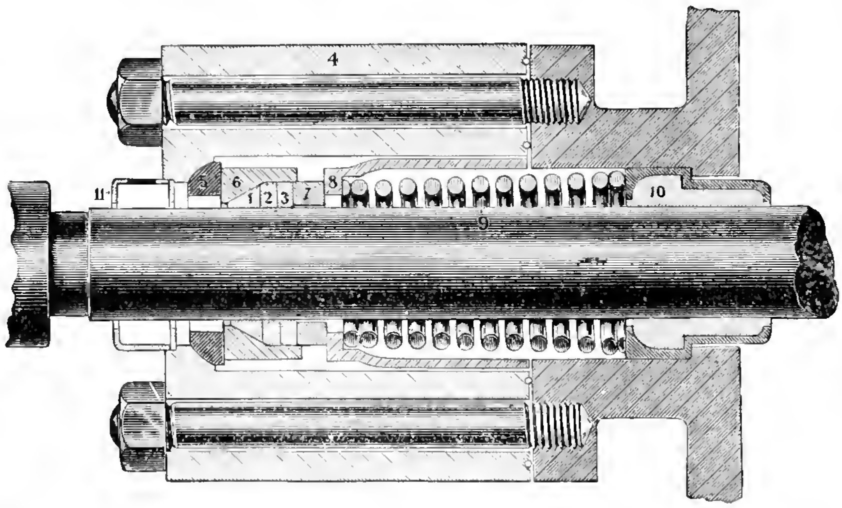
Simplest device for the purpose yet devised. Starts automatically when whistle is blown. Costs less for repairs, and the cheapest to apply. No bell-rope required,—sure starter.

Protection in lawsuits, automatic feature insures bell ringing at crossings — no other ringer can start automatically without our license.



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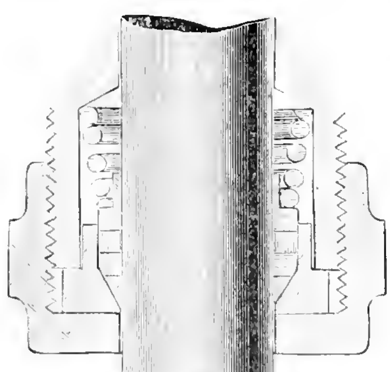
Will go in place of old glass tube. With 350 degrees of heat on inside a stream of ice water will not break it. One glass is a permanent part of the locomotive.

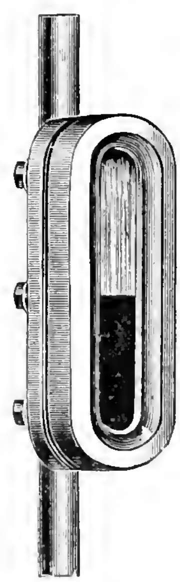
Economical, efficient and safe.

A trial will convince anyone of its merits.



"United States" Valve-Stem Packing.

Friction of rings back of the support of rod, improved oiling arrangement, swab protected from dust and dirt, shield in one piece but can be removed for renewal of swab in an instant. Same on piston packings. This packing has stood the test of years, thousands in use. You take no chances in using it—tried and true.



METALLIC PACKINGS

save their cost in fibrous packing in a year. They do not injure the rod. They require no attention but oiling. They put less friction on rods, never score and are tight.

Air Pump Rod Packing.

Giving A1 satisfaction on several roads. Saves time, labor and rods. Worthy of a trial. Try it.

Ask for our Catalog.

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MADE ONLY BY

HAGGARD & MARCUSSON,

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We refer by pe mission to "The Boys."

Drop us a card and we will send a list.

JUST LAY YOUR CUSHION ON THIS AND RIDE EASY.

Weighs only ten pounds. Price $2.00 for 18X24 and under. When ordering give your weight and state size desired. TERMS, C. O. D.

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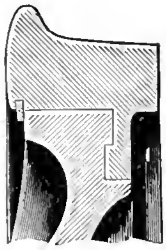

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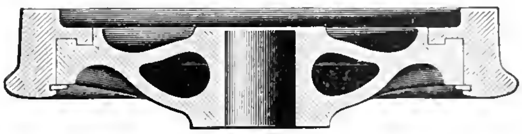
BOLTLESS STEEL-TIRED WHEELS

For Passenger and Locomotive Service.

Tires with Annular Web and Hook,
Best Charcoal Iron Double-Plate or Spoke Centers,
Wedge-Shaped Retaining Ring.



A Continuous Circumferential Fastening. Simple, Safe, Economical.

CHILLED IRON WHEELS
Of Superior Quality,
Drawing Room, Passenger and Freight Cars,
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Congdon Brake Shoes
For Chilled Iron Wheels,
Outwear from 4 to 6 ordinary Shoes and enhance mileage.

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For Steel-Tired Wheels.

ROSS, for Steel-Tired Car and Tender Wheels,
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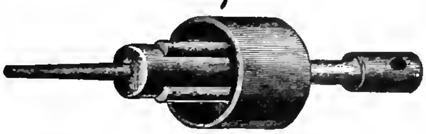

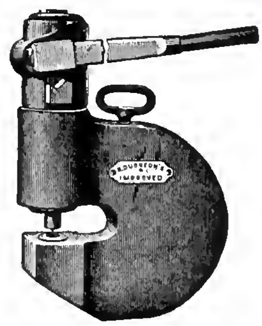

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HYDRAULIC JACKS

Punches, Roller Tube Expanders, and Direct Acting Steam Hammers.

☞ Jacks for Pressing on Crank-Pins or Car-Wheels made to order. Communications by letter will receive prompt attention.

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Watch Spring Tempered Steel.
Graduated in 32ds and 64ths on one side only.
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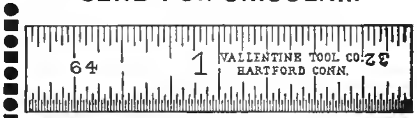

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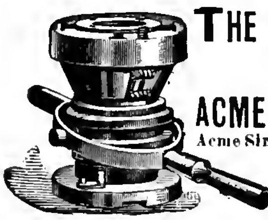
THE ACME MACHINERY CO.



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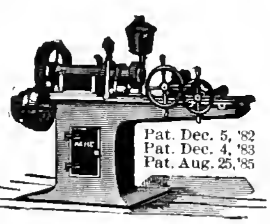
Cutting from ⅛ in. to 6 in. diam.
Also, SEPARATE HEADS and DIES.
First Premium Cincinnati Centennial.



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A sample of Dixon's pure, flake lubricating Graphite, with interesting and instructive pamphlet,

Sent Free of Charge.

Every engineer and machinist should make himself better acquainted with **Dixon's Pure Ticonderoga Flake Graphite.** It will save both time and labor, and is infinitely superior to the common forms of plumbago or black lead.

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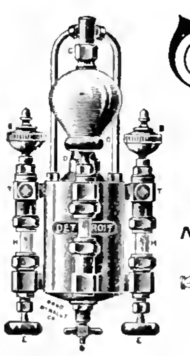

THE DETROIT IMPROVED SIGHT FEED CYLINDER LUBRICATORS

FOR LOCOMOTIVES

ARE WIDELY USED AND MOST FAVORABLY KNOWN.

No. 2. Oils both Cylinders. *No. 3.* Oils both Cylinders and the Air Pump. Economy in Oil, Expense for Repairs, and Glasses—the Leading Features.

☞ THE DETROIT AIR PUMP LUBRICATOR WILL RUN ONE THOUSAND MILES WITH HALF-A-PINT OF OIL.

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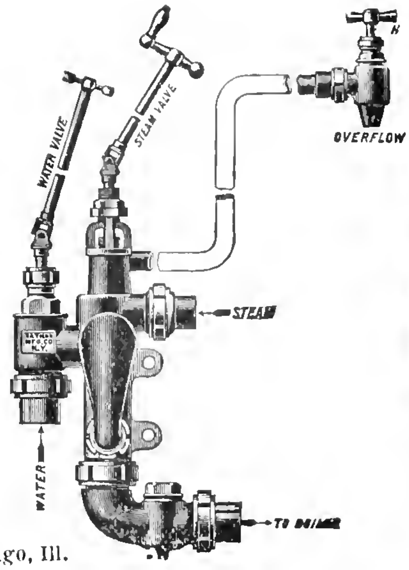
The New "NATHAN"

(See Illustration), and

MONITOR INJECTORS

for

LOCOMOTIVES.



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For Locomotive Cylinders and Air Brakes.

STEAM FIRE EXTINGUISHERS.
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BOILER WASHERS,
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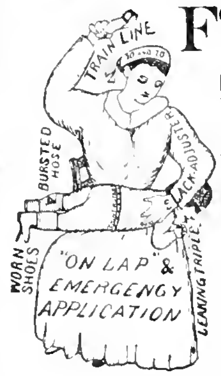

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Air-Brake Instruction.

Simple, Easy Lessons.

90 pages of Meat. Flexible Cover. Mailed to any address, on receipt of 50c.

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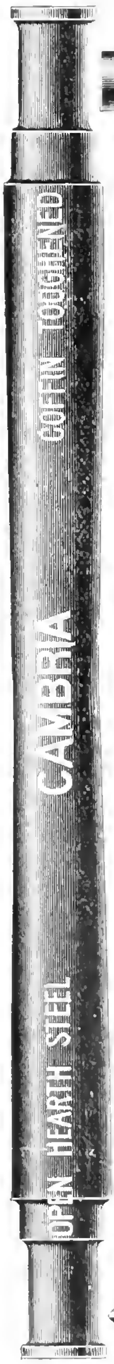

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WORKS AT
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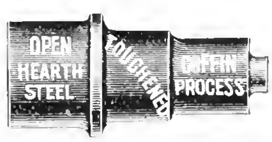
Driving, Truck, Passenger & Freight Axles, Piston and Side Rods, Crank Pins.



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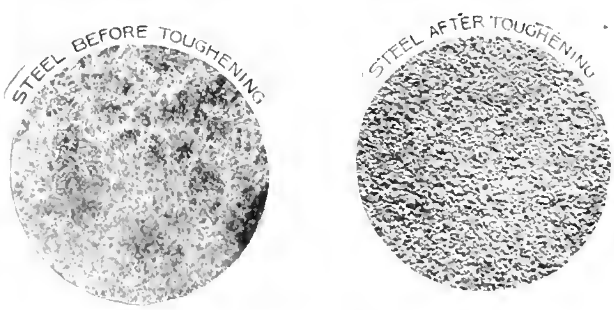

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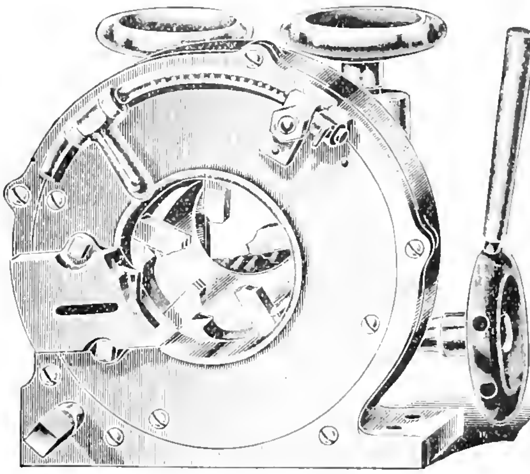

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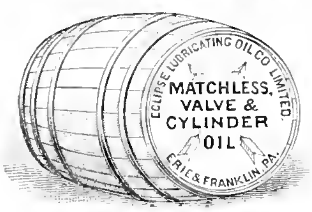

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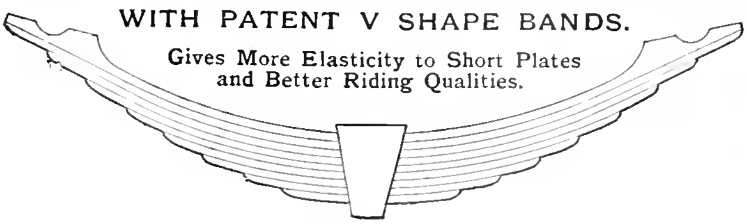

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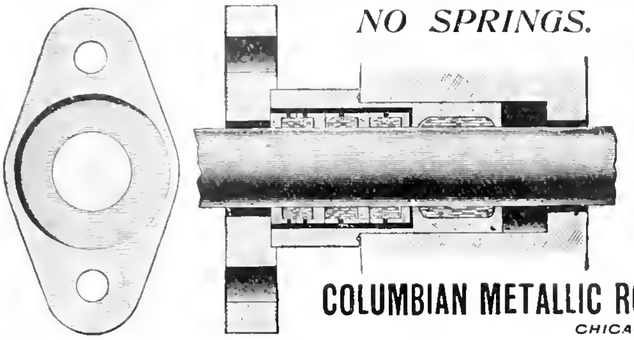

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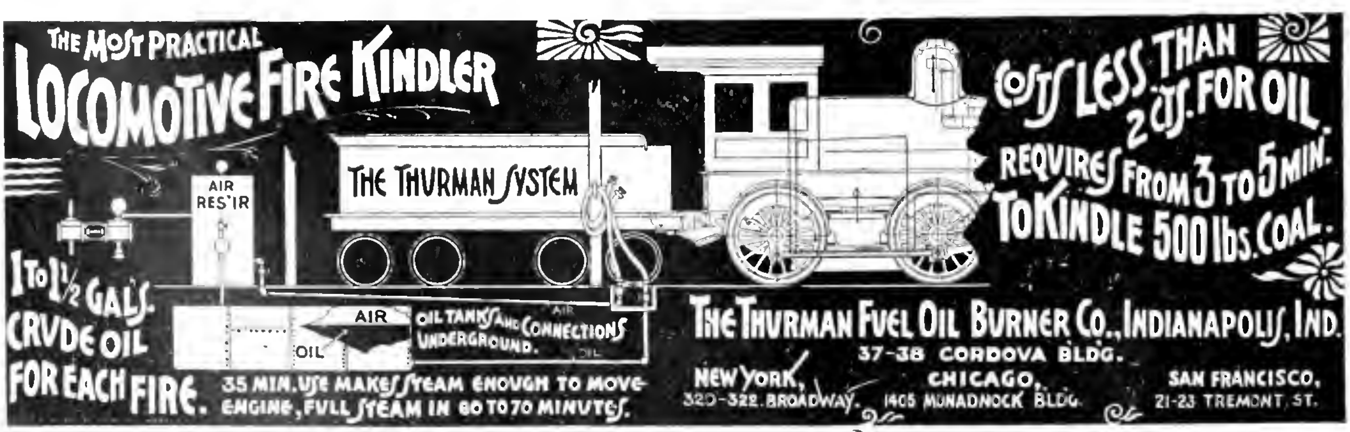

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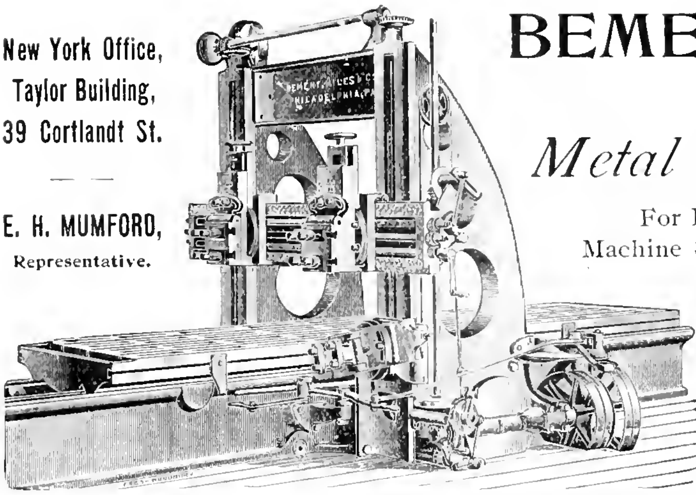

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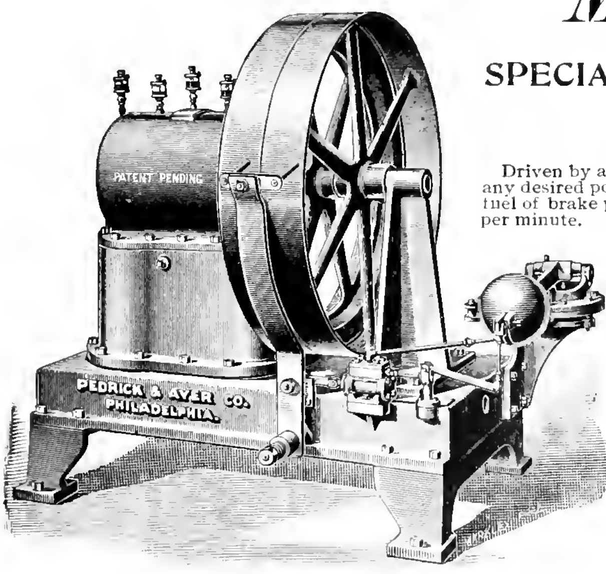

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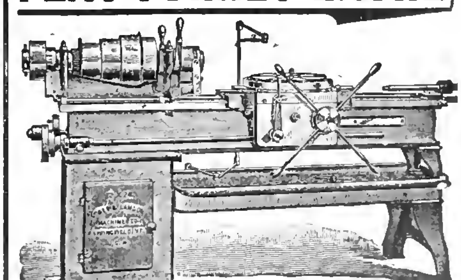

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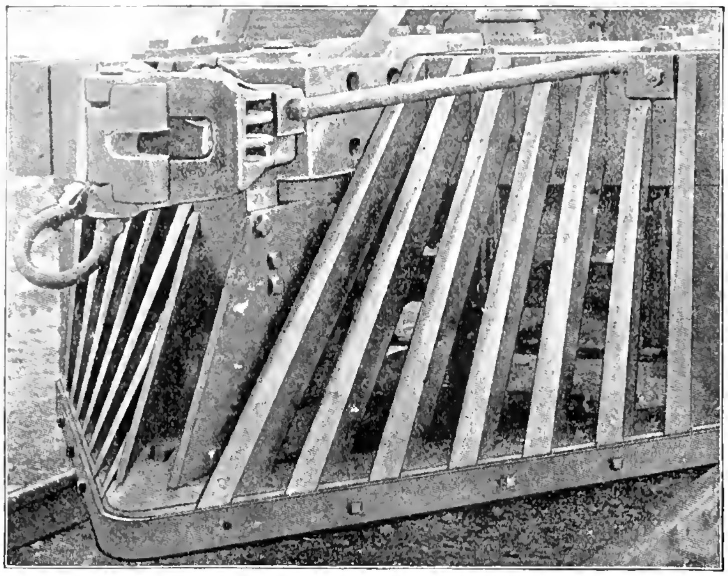

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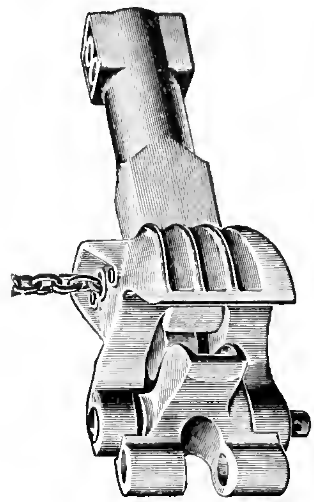

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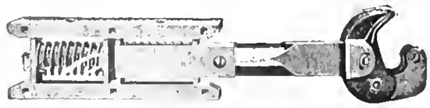

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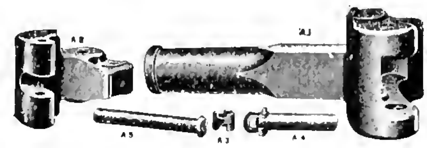

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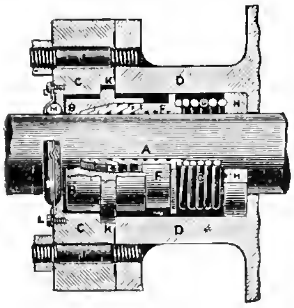

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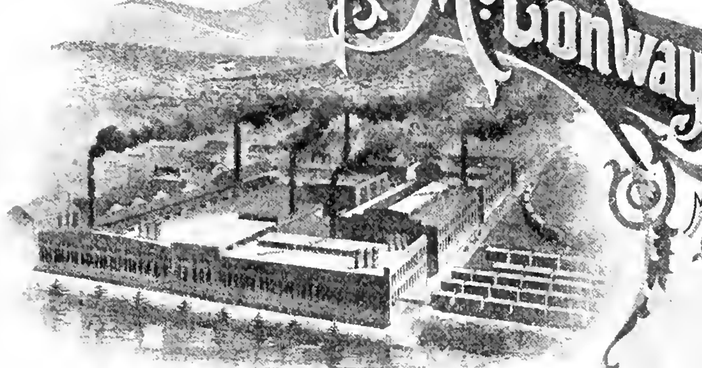

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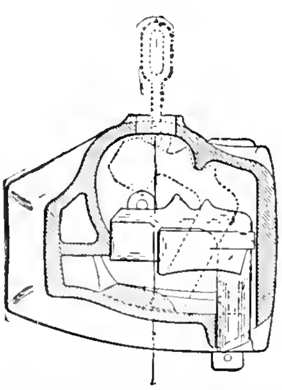

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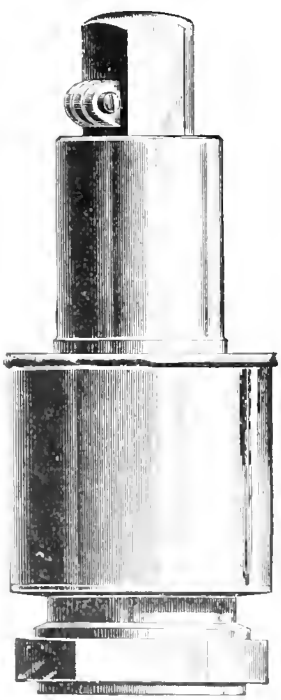

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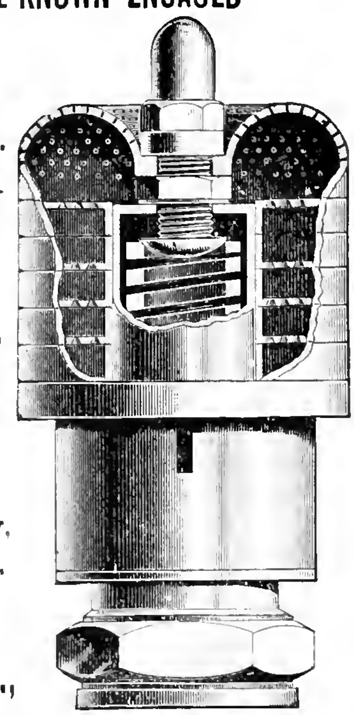

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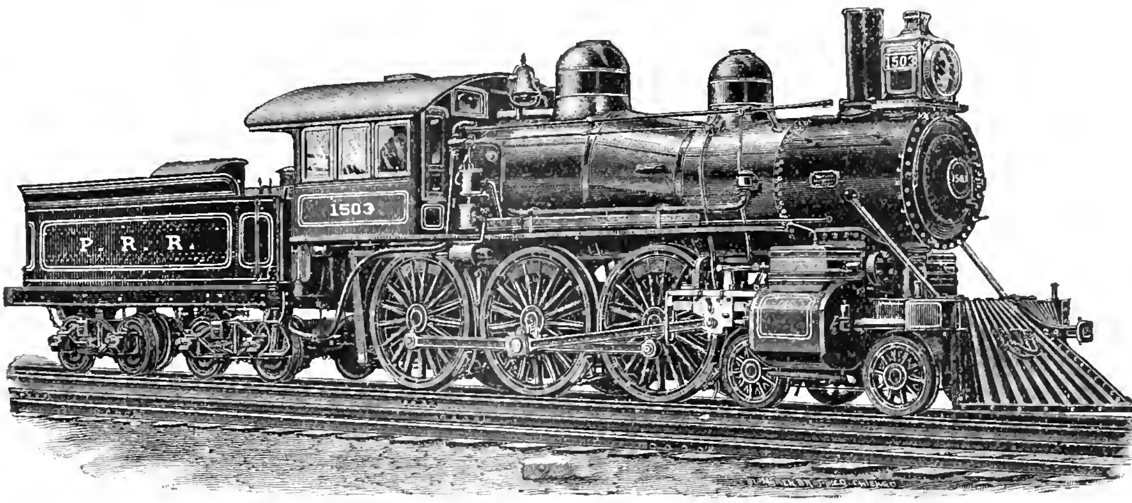

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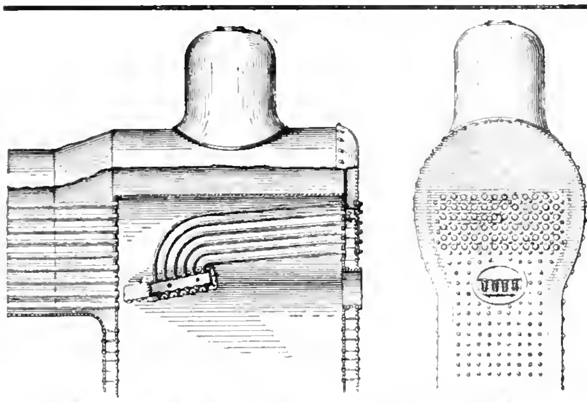

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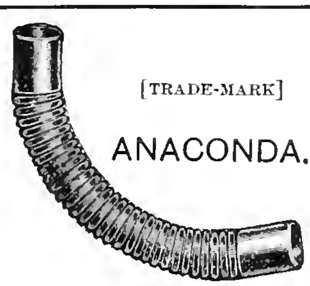

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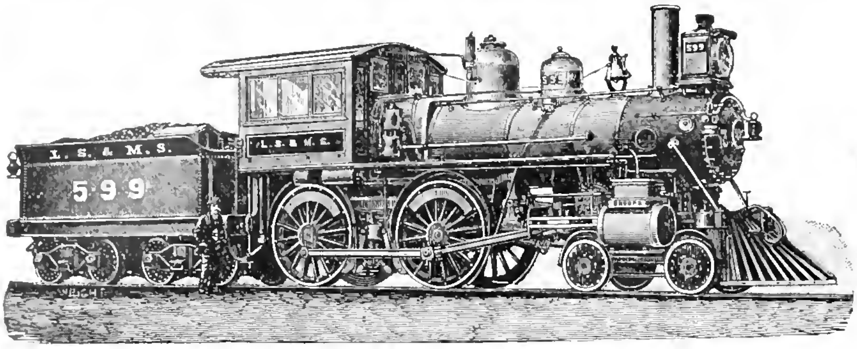

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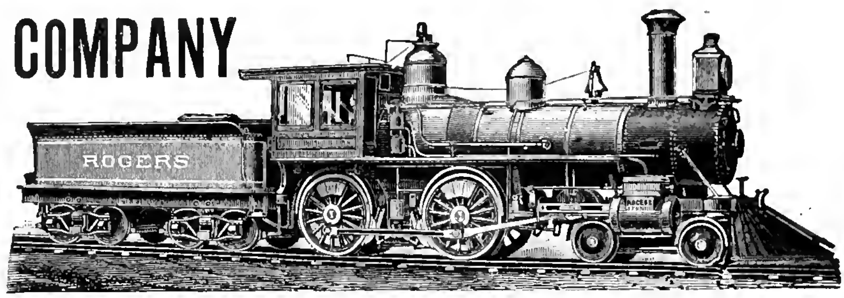

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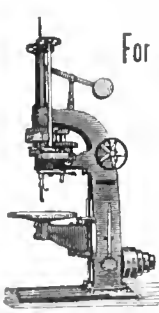

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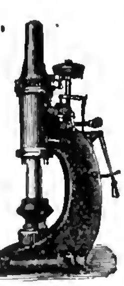

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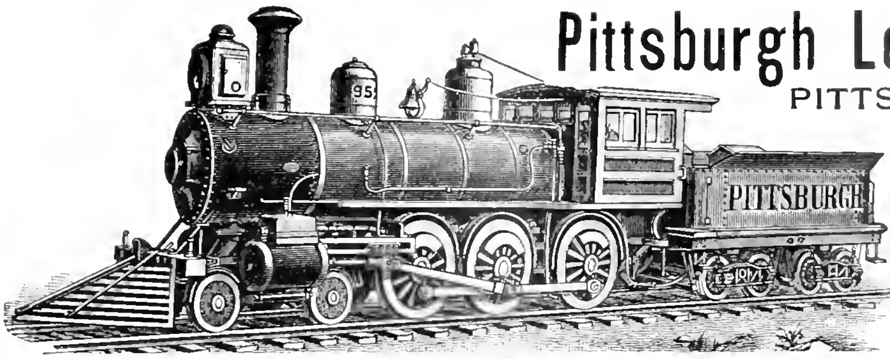

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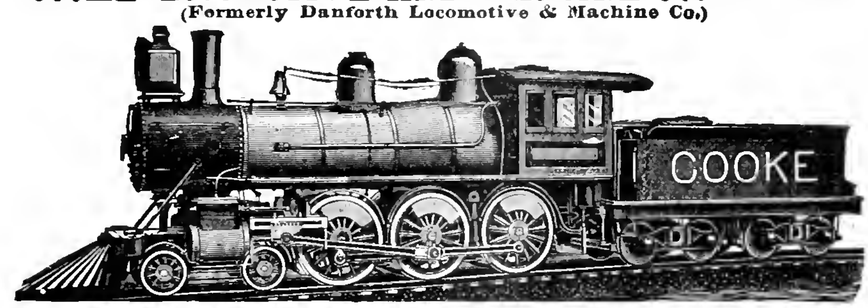

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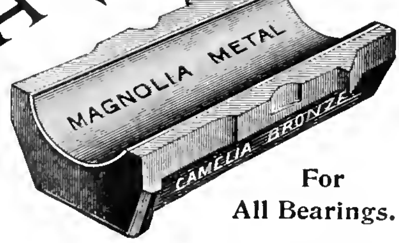

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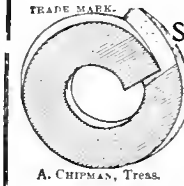

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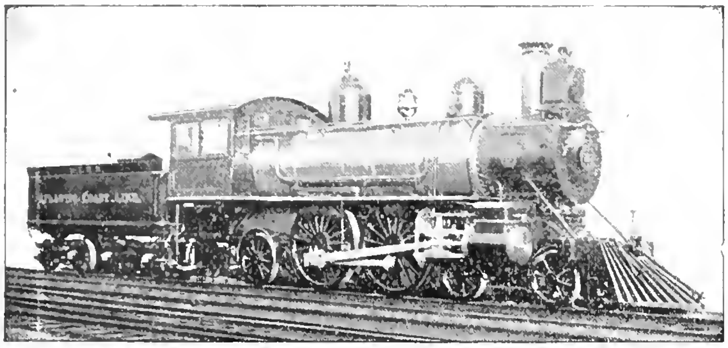

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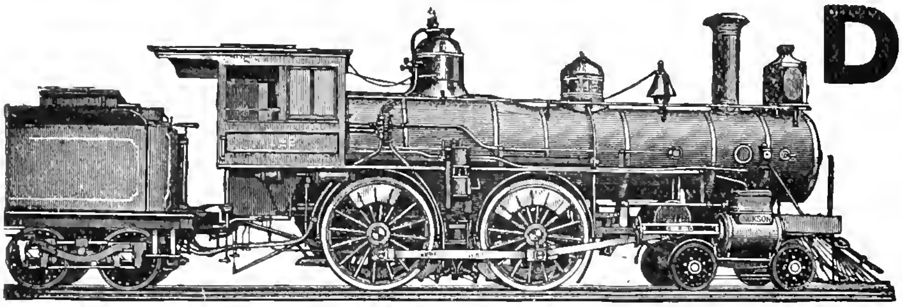

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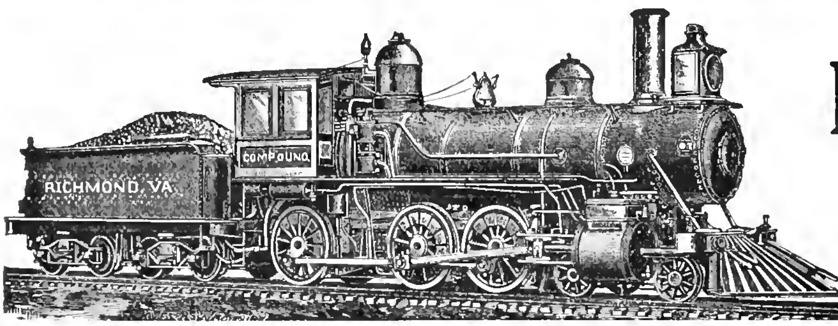

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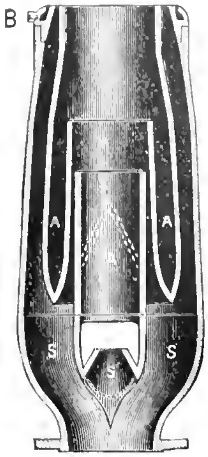
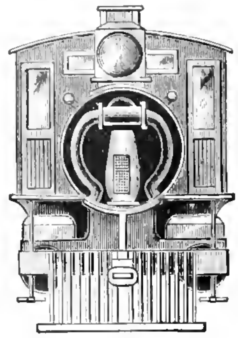
Continued on page 264.

The Smith Triple Expansion Exhaust Pipe.



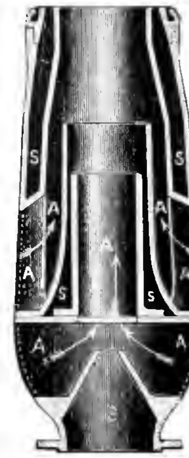
FRONT VIEW.

THIS DEVICE is the invention of JOHN Y. SMITH, the originator of the Smith Vacuum Brake. In the cuts of the Front and Side Views shown herewith, "AA" represent Air Passages; "SS" Exhaust Steam Passages, and "B" an Annular Blower forming part of the Nozzle.



It is an entirely new departure in the construction of Exhaust Pipes for Locomotives. Its distinguishing features are that the exhaust steam is not restricted after it leaves the cylinders, and the gases and heated air in the smoke arch are mingled with the exhaust steam in the exhaust pipe. The exhaust steam is thus superheated and expanded and a powerful, prolonged, pulsating blast is created, which keeps the fuel in a constant state of agitation, and produces more perfect combustion.

Some of the beneficial results obtained are: *Reduction of Back Pressure to a minimum (area of nozzle opening as large as the exhaust port); prevention of ejection of sparks from smoke stack; almost complete absence of noise from exhaust; prevention of formation of clinkers in firebox; large saving of fuel.*



SIDE VIEW.

By the elimination of Back Pressure we have demonstrated the fact that the power of engines has been increased to be able to pull from thirty to sixty tons more than with any other form of exhaust pipe.

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Screw Jacks.
Chapman Jack Co., Cleveland, O.

Shafting.
William Sellers & Co., Philadelphia, Pa.

Shorthand School.
Kerst College, Corning, N. Y.

Springs.
A. French Spring Co., Pittsburg, Pa.

Spring Steel.
Thomas Prosser & Son, New York.

Stay Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay Bolt Co., Cuyahoga Falls, O
B. M. Jones & Co., Boston, Mass.

Steam Gages.
Ashcroft Mfg. Co., New York.
Ashton Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.

Steam Hammers.
Bement, Miles & Co., Philadelphia, Pa.

Steam Hose.
Boston Belting Co., Boston, Mass.
Peerless Rubber Mfg. Co., New York.

Steam Pumps.
A. S. Cameron Steam Pump Works, New York.

Steel
Cambria Iron Co., Philadelphia, Pa.
Carbon Steel Co., Pittsburg, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York.)

Steel—*Continued.*
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg. Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.

Steel Tired Wheels.
Krupp (T. Prosser & Son, New York.)
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Standard Steel Works, Philadelphia, Pa.

Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son, New York.)
Standard Steel Works, Philadelphia, Pa.

Stone Crushers
Gates Iron Works, Chicago, Ill.

Surfacing Machine.
The Tanite Co., Stroudsburg, Pa.

Switches.
Ramapo Iron Works, Hillburn, N. Y.

Tanks.
Pittsburg Locomotive Works, Pittsburg, Pa.

Testing Machines.
Riehle Bros. Testing Machine Co., Philadelphia, Pa.

Tool Steel.
B. M. Jones & Co., Boston, Mass.

Track Equipment.
Ramapo Iron Works, Hillburn, N. Y.

Tube Expanders.
Richard Dudgeon, New York.

Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O.
Merrill Bros., Brooklyn, N. Y.

Turntables.
William Sellers & Co., Philadelphia, Pa.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.

Valves.
Ashton Valve Co., Boston, Mass.
Jenkins Bros., New York.
Ross Valve Co., Troy, N. Y.

Vestibules
Gould Coupler Co., Buffalo, N. Y.

Vises.
Merrill Bros., Brooklyn, N. Y.

Watches.
S. N. Clarkson & Co., Chicago, Ill.
John J. McGrane, New York.

Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia, Pa.

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Locomotive Engineering

A Practical Journal of Railway Motive Power and Rolling Stock.

May 1895.

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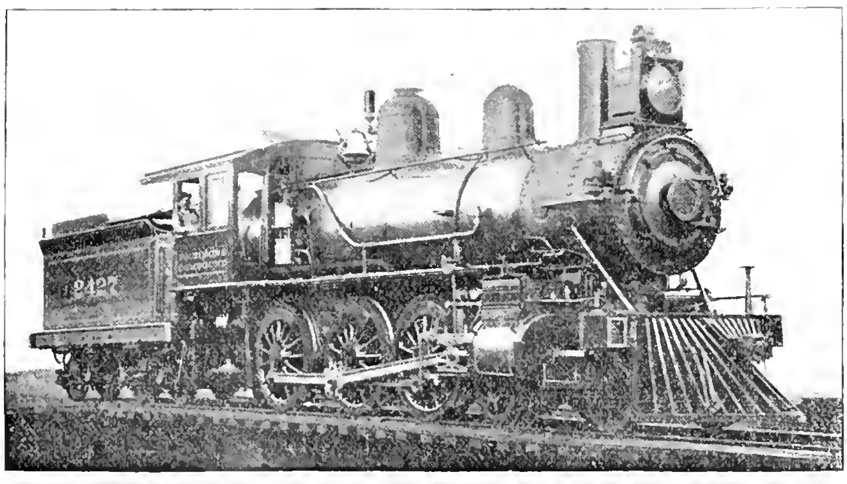
Richmond Compound Locomotive.

We present to our readers a perspective view of sections of various parts and indicated diagrams of a ten-wheel compound locomotive built by the Richmond Locomotive Works, which has been pulling all kinds of trains on the Chesapeake & Ohio Railway for several months past. The engine has been doing remarkably good service, and is highly popular with all the people who have anything to do with the handling of her. We also show a variety of indicator diagrams taken from the engine while pulling a vestibuled train of seven cars from Clifton Forge to Charlottesville, Va. An examination and study of the cards will show that the steam is remarkably well distributed for a compound locomotive. It will be noted that the work done on each side is surprisingly uniform for a two-cylinder compound.

The writer rode on the engine during a trip from Clifton Forge to Charlottesville, and the best testimony he can give is, that had it not been that he was aware previously of the engine being compound he could not have told so from the action of the machine. She ran as freely as a simple engine; there was an entire absence of pounding and jarring; and working heavy or light, she performed her duties very satisfactorily.

In the course of a letter received from Mr. W. S. Morris, superintendent of motive power of the Chesapeake & Ohio, he says: "I enclose you blueprints showing service tests of the Richmond Locomotive Works compound No. 2427, as compared with C. & O. engines Nos. 126, 127 and 238. The record this engine has made is surprising to all, and the figures are absolutely correct as reported by our man in charge of tests."



Richmond Compound Locomotive.

According to the record of tests referred to, the compound was tested on express, local and freight trains against two ten-wheel engines on passenger trains and a consolidation in freight service. The C. & O. passenger engines have cylinders 20 x 24 in. and over 2,100 sq. ft. of heating surface. The consolidation engine has cylinders 20 x 24 in. and 1,786.5 sq. ft. of heating surface. The compound has cylinders 19 and 30 x 24 in., which is equivalent to about a 20 x 24-in. engine, and the heating surface is 1,922 sq. ft. The capacity of the engines is about the same, except in the case of the consolidation, which has driving wheels 50 in. diameter as against 62 in. for the compound and others.

In express service the compound pulled $6\frac{1}{10}$ cars as against 7 cars for engine No. 126, and $5\frac{7}{10}$ cars for engine No. 127. The pounds of coal per ton mile were, for the compound, .293; for engine No. 126, .401; and for engine No. 127, .426. The gallons of water used per ton mile were .274, .308 and .328 respectively. The economy of coal in favor of the compound over the two others was 28.81 per cent. The saving in water was 13.84 per cent. The saving for the compound in local service over the other engines was 19.21 per cent. in coal and 17.51 in water. In freight work the compound showed an economy of 15.57 in fuel and 17.08 in water.

The compound is of the two-cylinder type, with a ratio of 1 to 2.5. In starting or on a heavy pull the engine can be worked simple by merely putting the reverse lever in the full gear notch. Linking up one notch puts the mechanism into compound working.

The annexed indicator diagrams were taken from this locomotive by Mr. F. F.

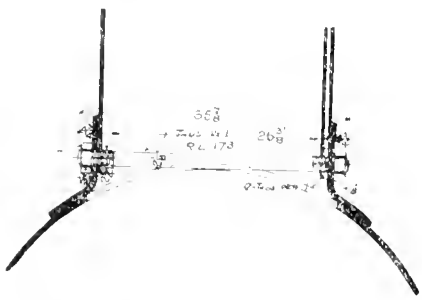
C. Davis, designer of the engine. The horse-power of the cards, worked out by a Willis planimeter, is as follows :

Card No. 1 — 455 horse-power.
" " 2 = 480 "
" " 3 580 "
" " 4 595 "
" " 5 507 "
" " 6 515 "
" " 7 598 "
" " 8 — 640 "

The following are the leading dimensions of the engine :

Running Gear—

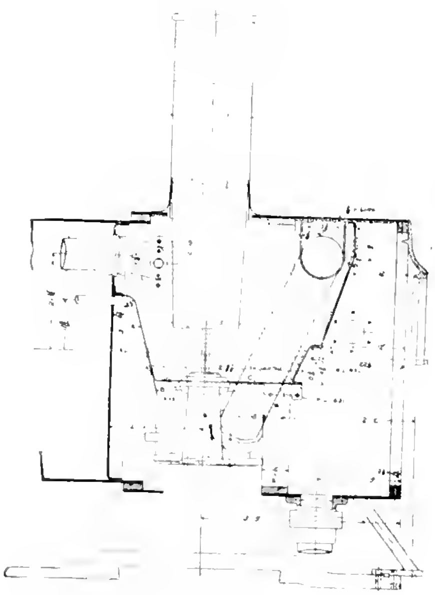
Driving wheels, diameter, 62 in.
Truck wheels, diameter, 30 in.



Tender wheels, diameter, 33 in.
Engine truck, rigid center.
Journals, driving axles, 8 x 10½ in.
Journals, truck axles, 5¾ x 10 in.
Journals, tender axles, 4¼ x 8 in.

Wheel Base—

Driving, 12 ft. 6 in.
Truck, 6 ft. 7 in.



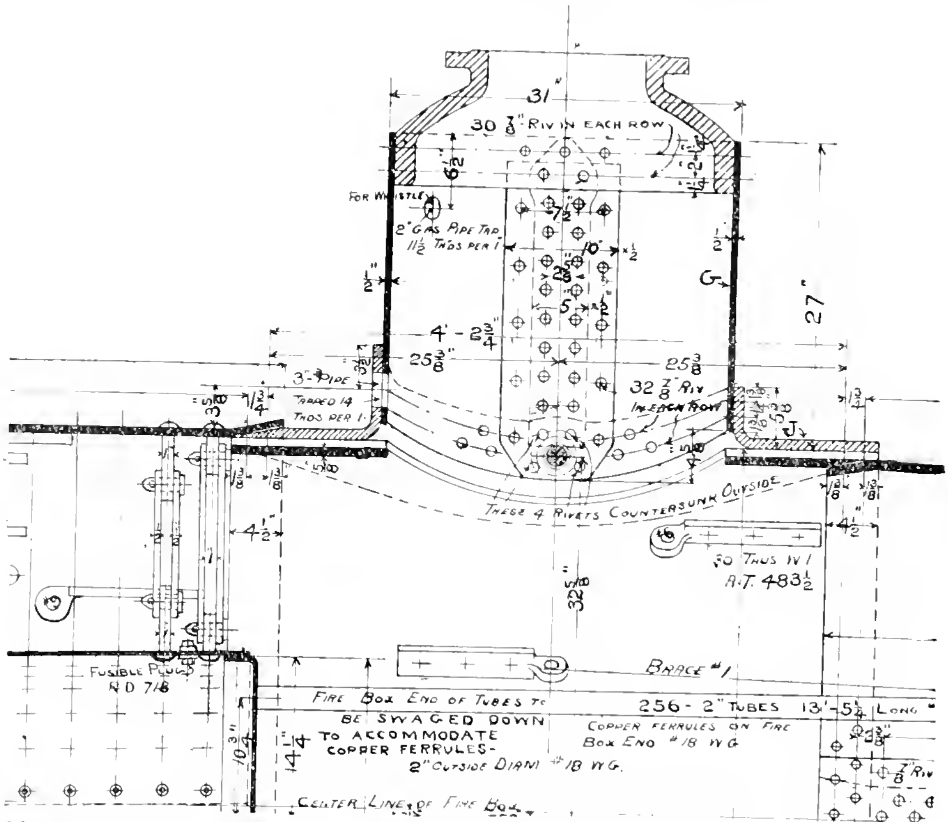
Total engine, 23 ft. 6½ in.
Total tender, 15 ft.
Total engine and tender, 49 ft. 5½ in.
Center of truck pin to center of leading driver, 7 ft. 11 in.
Driving wheels having bald tires, front pair.

Weight in Working Order—

On driving wheels, 115,000 lbs.
On trucks, 28,000 lbs.
Engine, total, 143,000 lbs.

Cylinders—

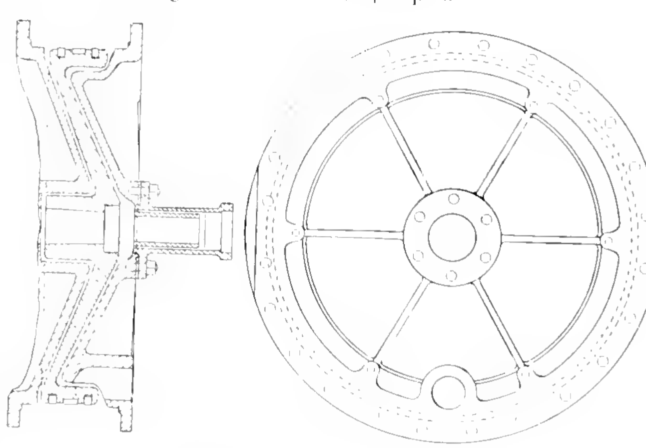
High pressure, 19 x 24 in.
Low pressure, 30 x 24 in.
Ratio of area of H. P. to L. P., 1 to 2.50.
Distance, center to center of cylinder, 7 ft. 4 in.
Distance, center of cylinder to valve face H. P., 17 in.
Distance, center of cylinder to valve face L. P., 21 in.



Piston rod, diameter, 3½ in.
Form of guides and crosshead, horizontal "H" shape.
Connecting rod, length between centers, 9 ft. 1¼ in.

Valve Gear—

Steam ports, high pressure, 1¼ x 23 in.
Steam ports, low pressure, 1½ x 23 in.
Exhaust ports, high pressure, 3 x 23 in.
Exhaust ports, low pressure, 3½x23 in.
Slide valves, Richardson balanced.
Slide valves, steam laps, high pressure, 1 in.
Slide valves, steam laps, low pressure, 1⅛ in.
Slide valves, exhaust laps, high pressure, ⅜ in.
Slide valves, exhaust laps, low pressure, ⅛ in.



Details of Steel Piston.

Boiler—

Type, extended wagon top, radial stays.
Diameter of barrel at front end, 60 in.
Thickness of shell, ⅝ in. and ¾ in.
Thickness of tube sheet, ½ in.
Height from rail to center of boiler, 8 ft. 2½ in.
Length of smokebox, 5 ft. 6 in.
Working steam pressure, 200 lbs.

Firebox—on top of frame sloping forward—

Length inside, 9 ft.
Width inside, 3 ft. 5⅞ in.
Depth at front, 5 ft. 10⅜ in.
Depth at back, 5 ft. 1⅞ in.
Thickness of side and back plates, ⅜ in.
Thickness of tube sheet, ½ in.
Grate area, 31.6 sq. ft.
Thickness of crown sheet, ⅜ in.
Staybolts, diameter, 1 in. and 1⅛ in.
Water space, width front and back, 4 in.
Water space, width sides, 3½ in.

Tubes—

Number, 256.
Diameter, 2 in.
Pitch, 2¾ in.
Length between tube plates, 13 ft. 3½ in.

Heating Surface—

Firebox, 140 sq. ft.
Tubes, 1,782 sq. ft.
Total, 1,922 sq. ft.

Miscellaneous—

Exhaust nozzle, diameter, 5¼ in.
Smokestack, smallest diameter, 15 in.
Smokestack, height from rail, 14 ft. 8 in.
Capacity of tank, 4,000 gallons.
Brakes, Westinghouse-American, equalized.

The Need of a Change in Car Inspection.

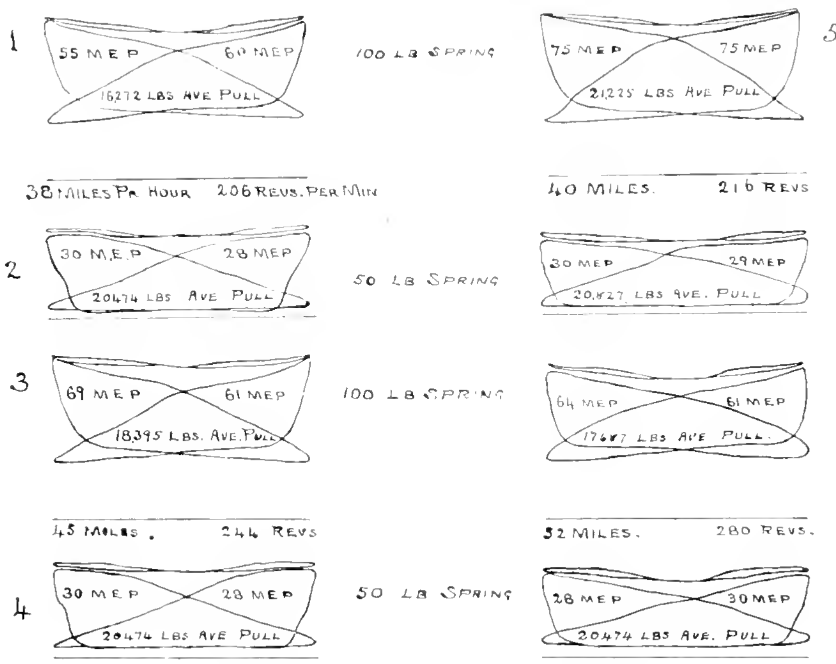
BY S. A. CHARPIOT.*

We have considered with much interest the remarks of Mr. Sanderson appearing in your issue for March, 1895, relative to "Responsibility of Owners for Defects in Cars." The paper and the chart certainly show very careful analysis of one of the aspects of the question. That cars represent a certain original outlay of the owners, and that any outlay ought to represent a certain revenue in relation to it, is a well recognized business proposition. That the revenues from such an outlay are very much increased or decreased by original good conception of design, careful selection of materials, due consideration of more or less well ascertained future maintenance, is known by the investors as some of the factors of success or failure of the outlay from a financial standpoint. The matter of mileage and revenues therefrom, however, we believe, ought properly to be classed as factors not to be considered by the mechanical department, only so far as necessary delays for inspection and repairs may bear upon them.

The fact, noted by Mr. Sanderson, of the small general average mileage, and the great variations therefrom on different systems, and even different divisions of one system, would not justly warrant the saddling of the onus of such conditions on the mechanical department.

It is doubtless true that in the near future greater care will be given to secure a more complete knowledge of all the facts bearing on the revenues from the capital represented by rolling stock. A close analysis of the subject will soon bring about conditions very different from those existing now. From the small mileage made it appears that there must be a great redundance of rolling stock. This may be true, and furthermore, the capital originally invested would probably now nearly double the original number of cars and provide the latest improvements and best construction. All these questions are somewhat outside of the problem under consideration.

Dishonest or unscrupulous charges will probably always appear as long as there are dishonest and unscrupulous people, and no rules will eradicate them, only modify their number and degree. That certain administrations, for financial or any particular reasons, might allow their equipment to run down, and would have to dishonor bills made by other roads for needed repairs, would soon regulate itself. Such administrations would soon have to keep their rolling stock at home.



INDICATOR CARDS, RICHMOND COMPOUND.

If, as stated, an inspection for safety only will expedite the transfer of cars, it seems fairly evident that the number of inspectors can be materially reduced, from the fact that now the greater part of their time is devoted to seeing that minor defects are carded for. The expense does not end there now, as the recording of cards, stubs, etc., is an item to be considered.

The fact that some motive-power officials have been, and may be now, employing incompetent men to discharge the duties of inspectors, should not bear on the question of liability of owners for defects on their cars, and we believe that the time has come to start from a new standpoint. It is not to be supposed that any reform, or any change, can be put in operation without some friction at first. It will require some time for a fairly normal equilibration of the conditions, but we are firmly convinced, that so far as the mechanical departments are concerned, the making of owners liable for the defects to their cars—when not caused by derailment or wrecks—will be a move in the right direction, and will in the near future bring forth results satisfactory to all parties concerned. It will be returning to original principles of interchange, as formulated as early as January, 1868, in the memorandum of agreement between the lines operating the then called "Green Line," section V: "All ordinary repairs, such as are necessary for the safe running of the cars, shall be made by the road on whose line the defects are discovered, without delay, and such repairs shall be charged to the road owning the cars." Section VI: "When damage occurs to cars from defection of track, running off, collisions, or other causes, the road on which the accident occurs, if in fault, shall repair the damages at its own expense."

If we have fairly good cars, the new rule cannot materially operate to our detriment; if we have old, obsolete, poorly designed and weak cars, the expense of maintaining them will devolve upon us instead of our more or less innocent neighbors, and we will soon be compelled to provide ourselves with better equipment. The questions of inadequate compensation for mileage, and others relative thereto, will be taken up and adjusted by the parties interested, when the necessity for such adjustment is made manifest.

* Formerly M. C. B. of the Central R. R. & Banking Co. of Georgia, and Secretary of the Southern & Southwestern Ry Club, Macon, Ga.

Tack Detectives on a Draft Timber.

"Railroad men are remarkably honest in their own personal affairs," remarked the Western S. M. P., "but they sometimes do things for their companies that ought to diffuse a blush of shame over a brass kettle.

"We had an experience with a particular car which illustrates the reckless way some railroads send to others bills for work they have not done. One of our cars came in several times carded for a cracked draft timber, and the car inspector directed my attention that the so-called crack was merely a drying check. I made an examination, and agreed with the view taken by the inspector. As a means of finding out whether the check grew longer, I directed the inspector to drive a tack in at each end of the check and let the car go. This was done. The car was gone probably a year before it turned up again at headquarters, and of course it was spotted over with defect cards, one being for the identical draft timber. On examining the timber, we found the tacks still there, and the crack no longer than it was a year before. But nine bills had come in from railroad companies, claiming payment for the cost of renewing that draft timber."

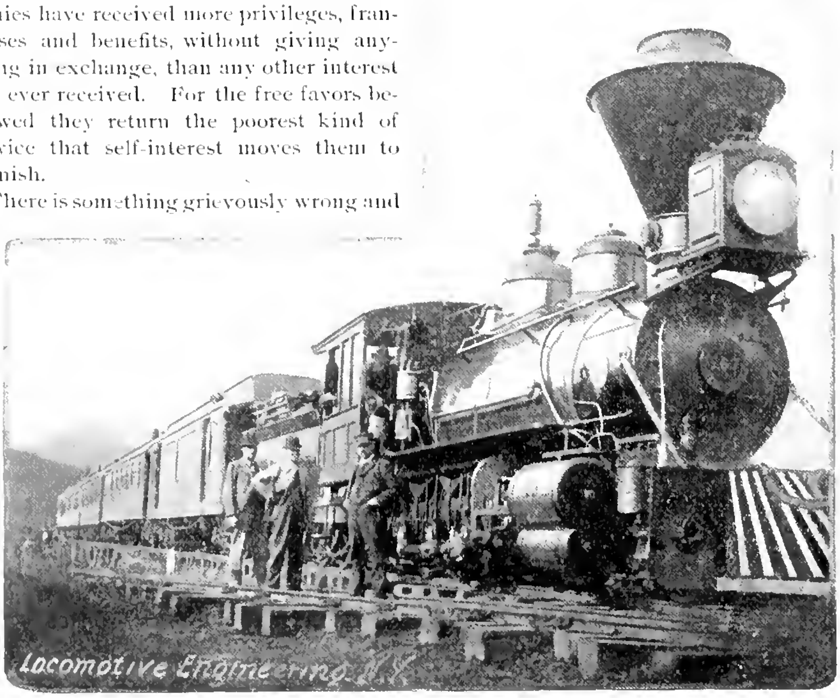
LOCOMOTIVE ENGINEERING is the only railroad paper published that conforms to the M. C. B. standard size.

Favors to Street Railways.

In a paper on the "Development of Electric Tramways," recently contributed to an engineering society, the writer makes the statement that "We may safely say that the electric tramways have more than met all the requirements, expectations and agreements of even the most enthusiastic advocate during their early introduction." This expresses the self-satisfied condition of most of those who have financial interests in electric street railways, but there is another side of the picture which is not so alluring or rose-colored. The public who depend upon street cars for accommodation, and those on whom the burdens of taxation fall, have the best of reasons to believe that street electric railway companies have received more privileges, franchises and benefits, without giving anything in exchange, than any other interest has ever received. For the free favors bestowed they return the poorest kind of service that self-interest moves them to furnish.

There is something grievously wrong and rotten about the privileges given to street electric railway companies. The air is constantly filled with the talk of new schemes for putting town and suburban travel into the hands of electric street railways, and those who have control of the franchises are reckless in the liberality displayed in giving free right of way on streets and other public highways.

There has been glee expressed freely of late that the street electric companies were cutting into the earnings of elevated and surface steam railroads that in various places had formerly carried a large volume of suburban passenger traffic. Those who delight in seeing the steam railway interests injured take a very narrow view of the subject. The steam railroads have been built and equipped at great expense, the right of way alone often representing greater outlay than the whole cost of putting electric railroads into operating order. The steam railroad companies require to pay much higher wages than those operating street cars, and they are taxed on the cost of their expensive property. The street railways have been built on right of way belonging to the public; the electric companies use cheap and dangerous methods of transmitting their power, they are notorious for paying low wages, and their taxes are based on the low cost, which has been made small because they use a roadbed which does not belong to them. Instead of being taxed only a small proportion of what steam railroads pay, they should be taxed higher on account of greater benefits received. It is high time that State legislatures and city corporations were adopting a policy which would give the public some of the benefits now monopolized.



Mexican National, on Top of Mexico, 8,000 Feet above the Gulf. Ed. Rinckle, Engineer.

Big Loss of Time.

He was a shrewd-looking man with trainman stamped all over him—the kind of man who would not count the ties when looking for a job.

He walked into the superintendent's office, and asked to see the old man with as much confidence as if he had been sent to report on the condition of the property.

"Personal business?" questioned the chief clerk. "Can I arrange it for you?"

"No; must see the head rooster."

When he was admitted to the inside sanctum he pulled out a package of letters, and explained that he was a conductor of thirteen years' experience, and was now ready to form a new connection—in fact, was willing to work for this road.

The superintendent was not hiring conductors just then, but the man had an impressive way with him that induced the super. to read the letters.

"You say you have been railroading thirteen years, but I see only eight years accounted for in these letters. What were you doing the remainder of the time?"

"Let me see," reflected the applicant, "that is about one-third of the time. Oh, I have it! That part of the thirteen years was spent in waiting for the engineer to oil around."

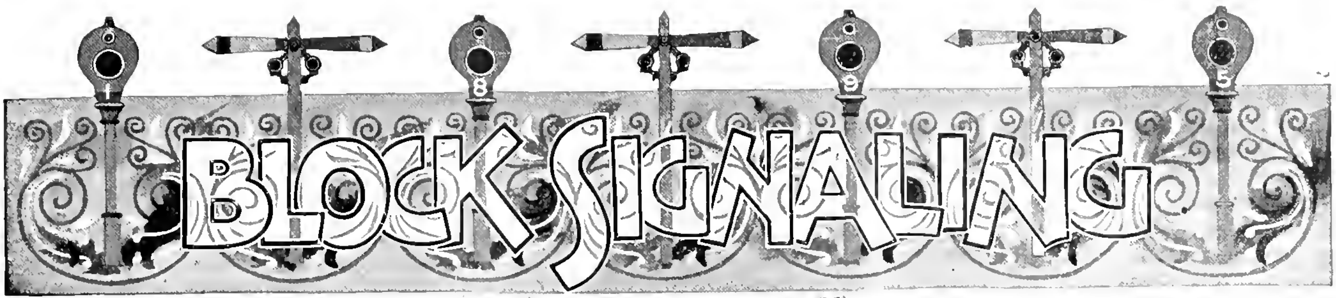
The super. reached for the button, and when the chief clerk came in, he said, "Give this man a badge and switch key, and send him out with Sam Ralston, who oils around at every crossing."

The Lightest Power Motor.

It is well known that the steam engine injector was invented by Giffard to be used in connection with machinery that the inventor was trying to perfect for the propulsion of balloons. The indications are that another engineer working on the problem of aërial navigation is going to give other valuable inventions to the mechanical world. Hiram S. Maxim, a well-known scientist, has lately devoted himself to the invention of a flying machine, and, in connection with the work, he has perfected some extraordinary improvements on steam engines and boilers. If a flying machine is to be made a success, it is highly important that the motive power should be light.

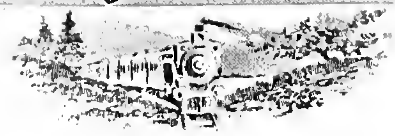
In an article contributed to the *Century Magazine*, describing his labors on a flying machine, Mr. Maxim says that, before selecting his motive power, he went carefully into the weights of all kinds of motors. He found that the weights per indicated horse-power of different motors were: Hot-air engine, 200 pounds; oil engine, 75 pounds; electric motors, fed by secondary batteries, 130 pounds; Otto system, 50 pounds; steam engines, with condenser pump and everything complete, such as used on boats, from 25 to 50 pounds per horse-power. He designed and put into operation a steam engine, with boiler, gas generator, pump and 200 pounds of water, which weighed only 5.6 pounds to the indicated horse-power. With this light motor, the prospects of flying machines being made successful are very promising.

Persons interested in getting good work out of emery wheels ought to send to the Tanite Co., Stroudsburg, Pa., for their illustrated catalogue of emery-wheel machinery. There is an impression in some shops that an emery wheel is the cousin-german of a grindstone, and does its work without any care or attention. It does, as a rule, but intelligent care and handling will greatly increase the amount of work done on any wheel. The catalogue referred to gives much interesting information about emery wheels, a kind of knowledge greatly needed in the ordinary shop.



Construction—The Automatic Electric Systems.

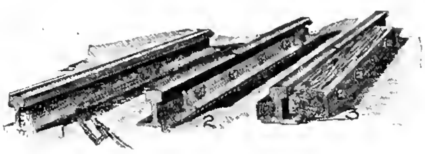
[FIFTH PAPER.]

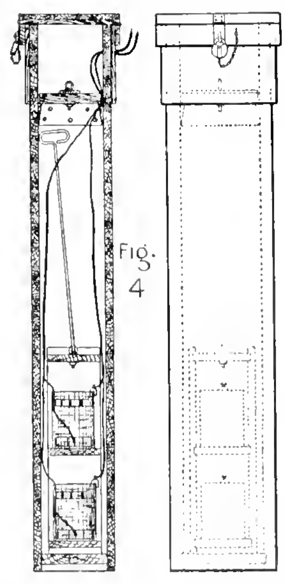


By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

The automatic systems may be divided into two classes, the automatic electric and the automatic mechanical, the distinction being made in the power used to operate the several systems.

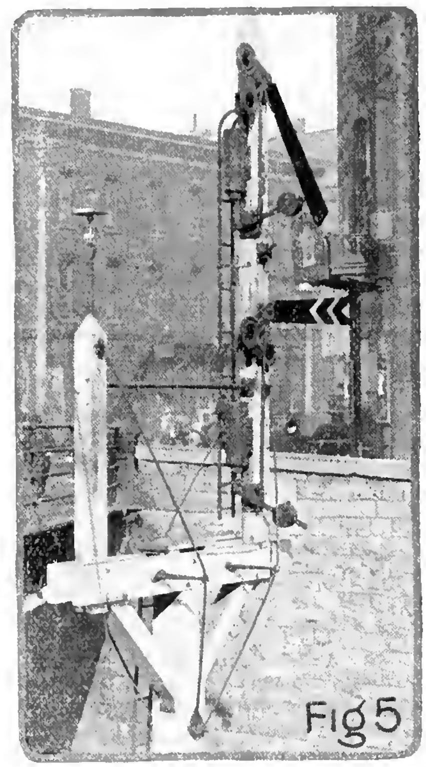
It is the purpose of this article to consider the automatic electric systems only; but before doing so, it would be well to say a few words about the electric battery and the relays that are used with these systems, for it is upon the proper arrangement and construction of these two things, more than anything else, that an electric system depends for its proper working. The battery used is the one commonly used for telegraphing, and is what is known as the gravity battery, being made by placing a piece of copper and a piece of zinc in a glass jar and surrounding them with a solution of sulphate of copper. Chemical action takes place between the sulphate of copper and the zinc, resulting in the formation of an electric current flowing from the copper to the zinc, if the two are connected by a wire to complete the circuit.





If the wire in which the current of electricity is flowing is wound around a piece of iron, it will cause the iron to become magnetized in proportion to the amount of current and the number of turns of the wire. If the iron is soft or annealed, it will lose its magnetism when the circuit is broken. A piece of steel or hard iron will retain a part of its magnetism and become a permanent magnet. It is this property of a piece of soft iron to become magnetized by a current of electricity and then to lose its magnetism when the circuit is broken, that is made use of in the construction of the relay to transform the energy of the electric current flowing through the wire into the motion of the relay armature. For, by arranging a piece of soft iron in front of the poles of the magnet, it will be attracted when the magnet is energized and pulled away, either by a spring or gravity, when the circuit is broken and the iron loses its magnetism, thus imparting a certain motion to the piece of iron each time the circuit is completed or broken. The piece of iron is called an armature, and the motion imparted to it is the one made use of in doing any mechanical work by electricity, whether it be to make or break electric circuits, to move valves, to turn a pulley, or any of the thousand and one instances that we find in every-day use.

Electricity is susceptible of measurement, the same as if it was a piece of solid matter having size and weight, and while science is yet unable to say that it is anything more than a force, its laws and properties are well understood. The electrical units of measurement are the "ampere," the "volt" and the "ohm"—the ampere measuring the amount of current that is flowing in a given circuit, the volt being the tension or pressure existing between the two poles of the battery, and the ohm the resistance offered by the wire, or other parts of the circuit, to the passage of the current. The amount of electricity flowing through a given resistance is directly proportional to the pressure; the lower the resistance, the greater will be the amount of electricity flowing with a given pressure; the greater the resistance, the greater must the pressure be to send a given current of electricity through that resistance. If there are two channels through which a current of electricity can flow, the amount flowing through each will be inversely proportional to their resistance. A gravity cell, such as is used to work the different relays, gives a current of one-quarter of an ampere, at a pressure or electromotive force of .9, or about one volt, and has an internal resistance of four ohms to the passage of a current of electricity. If the cells are arranged in series—that is, with the copper of one attached to the zinc of the next—the electro-motive force or voltage is increased one volt for each cell, and the amount of current remains at ¼ ampere; if the cells are in parallel, with all the coppers connected to one wire and all the zincs to the other wire, the electro-motive force remains the same, while the amperes are increased ¼ ampere for each cell.



THE ELECTRO-PNEUMATIC SIGNAL.

Having these facts and figures, we are now in a position to take up and consider the arrangement of a track circuit, the relay, and the action which takes place when a train runs on the track circuit; for, as the track circuit is the controlling agent

of the best of the automatic electric systems, it is necessary that a thorough understanding be had of the part that it plays in the successful working of such a system.

In equipping a road with an automatic electric system, the track is divided up into blocks of any desired length, a signal of the pattern adopted being placed at the entrance of each block. The rails of each block are made into a track circuit by insulating the rails of one from those of the next block, by means of a fiber end piece of the same size as the rail, and by using wooden splices in place of the iron ones, as shown in Fig. 3.

It has been found impossible, in practice, to make the length of any one circuit longer than 3,000 feet, owing to the increase of the resistance of the circuit, causing in wet weather such a loss of electricity, by leakage across the track from one rail to the other, that enough electricity does not flow through the relay to magnetize it, producing the same result that a pair of wheels would if it were in the block. In consequence of this there may be several track circuits or sections in a block, each one being insulated and separate from the next, but so arranged, by means of relays, that the same results are obtained as with a single-track circuit the length of the block.

Each rail in the section is joined with the one next it by a bond wire, as is shown in Fig. 2, for the purpose of making a continuous circuit from one end of the section to the other, the contacts made by the angle bars being imperfect on account of wear, rust or the loosening of bolts. There are two bond wires to each joint, being usually placed on opposite sides of the rail; so that if, from any cause, one should get broken, the circuit would be maintained through the other one. At the end of each section furthest away from the signal, a battery of two cells is located, the two poles of which are respectively joined by wire to the two lines of rails; the manner of attaching a wire to a rail being shown in Fig. 1, the connection between two wires being soldered.

The cells, for protection, as well as to prevent their freezing in cold weather, are placed in a box or battery well, shown in Fig. 4, and buried in the ground. At the signal end of the section a relay is placed, being connected by wires to the two lines of rails, and in this way establishing a complete circuit from the battery to one rail, from the rail to the relay, from the relay to the other rail, and from that rail back to the battery. Owing to the fact that water makes the earth a fairly good conductor, it is necessary that the resistance of the circuit be kept as low as possible, so that even under adverse conditions there will be less resistance through the relay than across the track, and the electricity will follow the rails and energize the relay, making it work properly in all kinds of weather. To keep the amount of electricity that leaks across from one rail to the other as small as possible, the two cells are arranged in parallel, the current of electricity being increased thereby, while the voltage or pressure remains the same as with one cell. This reducing of the pressure reduces the power of the current to flow through a certain resistance, so that where there would be a large leakage of electricity across from one rail to the other, if the cells were in series, there would be but very little if they were in parallel, the current flowing through the relay instead and energizing it. In practice it has been found that the resistance of the relay should very nearly equal that of the external resistance of a circuit; but as the resistance of a track circuit is only half an ohm, it is practically nothing, and so the relays are made of the same resistance as a cell, or four ohms.

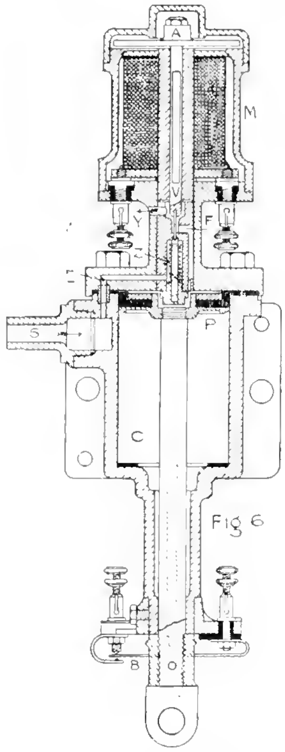


Fig 6

The relay used in connection with a track circuit, from the nature of the work, must be a very sensitive one and able to work with the least possible current. The magnets should be comparatively large, the armature light and well proportioned, and the parts well fitted without lost motion, so that a maximum of pressure for a given current will be exerted on the platinum points and a good contact made. The working parts of the relay should be enclosed in a dust-proof box or case, so that no foreign substance can get between the points and thus prevent a contact.

Assuming that everything has been properly arranged, and that a current of electricity is flowing through the relay, energizing the magnet and attracting the armature; if now a train, or even a pair of wheels, should enter the section, a short circuit would be formed from one rail to the other, cutting out the relay, as there is practically no resistance through the wheels and axles—the current from the battery flowing to the rail, from that rail through the wheels to the other rail, and back to the battery.

When the current is cut out in this way, the relay loses its magnetism and the armature drops, separating the contact points on the end of the armature, thereby breaking the current passing through them.

This other or second circuit flowing through the contact points is a more powerful one than that used for the track circuit, and is the one made use of to operate the signal, whether this is done by the application of electro-magnetism to the parts of the signal, or by controlling the action of compressed air, or the force of gravity, any of which may be the power actually used to work the signal. The battery cells in the second, or signal circuit, are arranged in series, as the resistance of the relays and the wires connecting the signals is much greater than it is with a track circuit. The number of cells varies with the number of signals to be operated by the circuit and the length of the wire connecting the signals, or, in other words, according to the resistance. If the resistance is low, few cells will be required; if high, it means that there is more work to be done, and a greater number will have to be used. The number

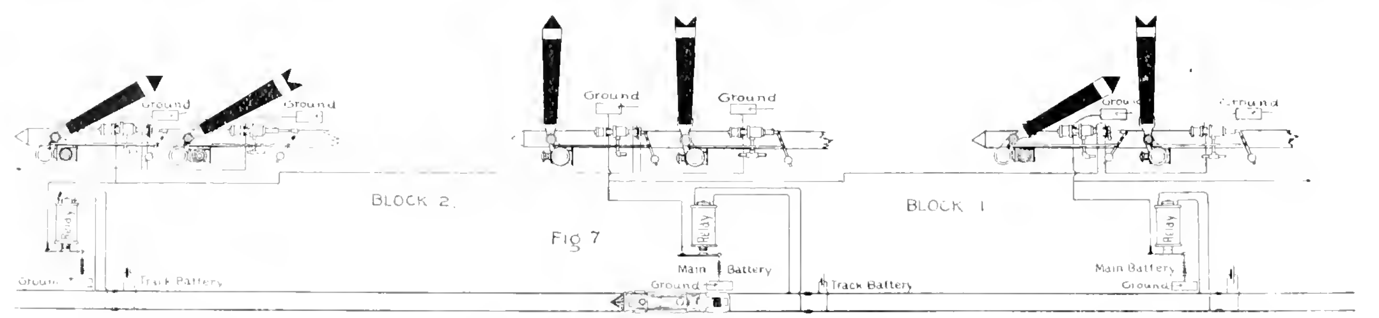


Fig 7

used varies all the way from from four to twelve cells for each circuit, eight being about the average number required for blocks one-half mile long. The cells are either placed in battery wells or in small houses built especially for the purpose. These are generally sunk in the ground to prevent the cells freezing in cold weather.

The length of the blocks varies on al-

THE HALL SIGNAL.

most every road; but as the expense of maintenance of an electric signal is small, the blocks are usually made much shorter than where operators have to be employed to work the signals. Then, again, as the length of the block regulates the distance apart which it is necessary to keep trains—the shorter the blocks, the greater being the number of trains that can be run in a given time—there is every advantage to be had in making them as short as the amount of money the road can afford to spend in this direction will allow.

An excellent feature of the track-circuit system is the ease with which switches and side tracks can be connected with the signal, and, by setting the signal at danger, stop a train if the main line is not clear.

A switch is protected by running either the track or the secondary circuits through a circuit breaker, worked from the points of the switch. If the switch is set for the main line, the circuit is not interrupted, and the signal shows "All Clear." If, however, the switch is open, the circuit is broken, and the signal will indicate danger.

By wiring up the ends of the side track and making it form a part of the track circuit, any train standing on that portion of the track will keep the signal at danger the same as if it were on the main line; so that whenever a train enters a side track in the block, the signal remains at danger until the train has entered the siding and cleared the main line.

A track circuit also affords protection against a broken rail for if this should happen, the circuit through the rail would be broken, from a separation of the ends of the rail, and the signal would be set at danger.

Everything that has so far been considered is common to all the automatic track-circuit systems, and may be said to be the ground work upon which they depend for their proper working, so that it is from this point that they diverge to the several devices which constitute the different systems.

Taking up the Westinghouse pneumatic system, it will be remembered that this system makes use of the ordinary semaphore to give the different indications of the state of the block, the work of moving the signal being performed by means of compressed air controlled by a valve, operated by an electro-magnet; the compressed air being supplied from a central pumping station, at a pressure of sixty pounds, and in as dry a state as possible, to prevent clogging the apparatus from the condensation of water.

The general arrangement of the apparatus showing the connections to the signal blade are shown in Fig. 5, the photograph being made of a signal on a road where green is used for the all-clear signal. It will be noticed that the signal casting is made to hold two glasses, one red and the other green, that one being brought in front of the lamp which will give an indication corresponding with the position of the blade. As is customary where this system is in use, there are two blades on the one pole—the upper a home signal, painted red, and governing the block immediately ahead; the lower, a cautionary signal, painted green, and working in connection with the home signal of the next succeeding block. Each signal is operated by a piston working in a cylinder which is three inches in diameter, the piston rod being so connected to the balance lever as to move the signal to the safety position, when air is admitted from the supply pipe to the cylinder; the weight of the signal casting and that on the balance lever, if such is necessary, causes the signal to return to the danger position when the air is released. From this it is seen that although the normal position of the signal is at safety, not at danger, the fact of its being at safety is a sure indication that everything is all right; for if anything should happen to the air supply, or any of the parts become disconnected, or either of the circuits get broken, the signal would immediately assume the danger position, and remain there until the defect was remedied. The details of the cylinder, the valve and the electro-magnet are clearly shown in Fig. 6, the parts being shown in a position corresponding with the danger position of the signal. *M* is the magnet, *A* the armature, and *V* a valve worked by the armature. *P* is a piston working in the cylinder *C*, *S* the pipe by which air is supplied; *E*, *F* the passages for admitting air to the cylinder; *X* a valve worked by the spring *Z*, to shut off the supply of air whenever the current passing through the magnet *M* is broken; and *Y* the exhaust opening into the atmosphere by which the compressed air is allowed to escape. *B* is a circuit breaker, worked by a pin on the side of the piston rod, being so arranged as to break the circuit operating the cautionary signal whenever the home signal assumes the danger position.

The operation of the signal may be explained as follows: Supposing the signal to be in the danger position, and that the signal circuit, or the one energizing the magnet, had just been closed by the track-circuit relay. The current would then flow through the magnet *M*, causing the armature *A* to be attracted. This presses the valve *V* from its seat, at the same time seating the valve *Y*, closing the exhaust and allowing air from the supply pipe *S* to flow along the passages *E* and *F* into the cylinder behind the piston *P*, forcing it through the cylinder the length of its stroke and clearing the signal. As the piston was pressed down, the spring of the circuit breaker would be released, the cir-

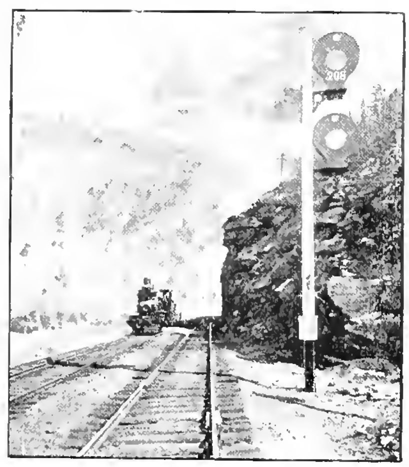


FIG. 9.

cuit closed, and, if the next succeding block was clear, the cautionary signal would also assume the "All Clear" or "Safety" position.

A diagram representing a piece of track, divided into several block sections, with the necessary signals and the several electric circuits, is shown in Fig. 7. The upper signal, with the pointed end, on each pole, is the home signal; the lower one, with the end notched, is the cautionary signal, showing the condition of the next succeeding block ahead. An engine is supposed to be in Block 2, the signals of the several blocks being shown in the position they would assume in consequence of this block being occupied. In Block 1 we find that, as there is no train or part of a train in this block, the current from the battery is flowing through the rails of the block and energizing the relay, the armature being

held up and the signal circuit closed. This energizes the magnet of the home-signal cylinder, and, by attracting the armature, opens the valve and admits air to the cylinder, clearing the signal.

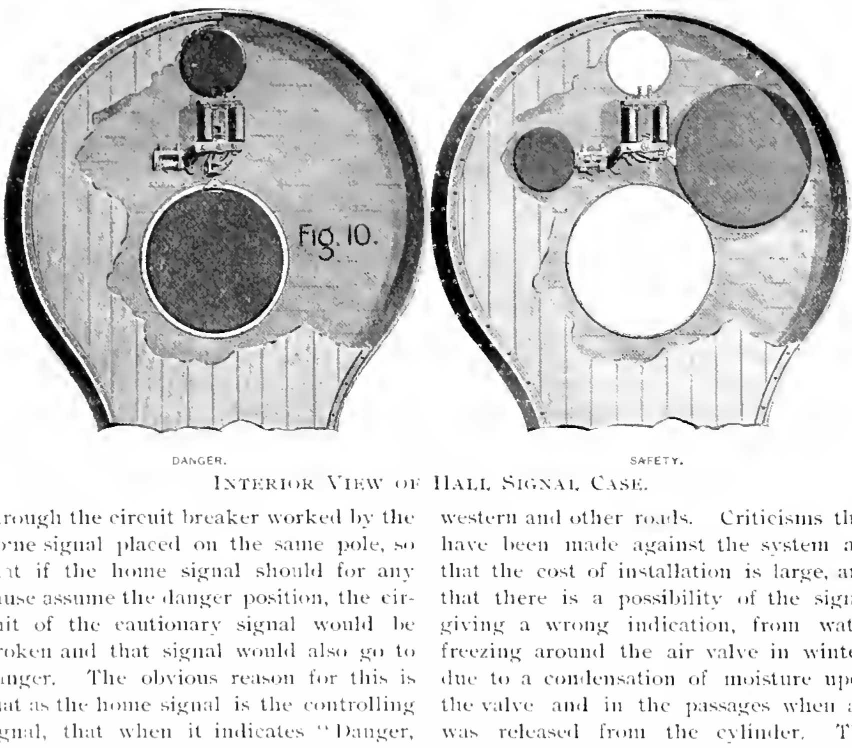
As the lower, or cautionary signal, must indicate the condition of the next succeeding block, the signal circuit operating the magnet must be controlled by the track-circuit relay of that block, and, as the relay is short-circuited by the engine in that block, the signal circuit is broken and the signal is shown at danger. This is clearly shown by tracing out the two circuits of Block 2. The armature of the relay is down, breaking the signal circuit at the point *E*, the current from the main battery being cut off from the magnets operating the home signal of Block 2 and the cautionary signal at the entrance of Block 1—the signals, in consequence, indicating danger.

It will be noticed that the circuit operating the cautionary signal is made to pass through the circuit breaker worked by the home signal placed on the same pole, so that if the home signal should for any cause assume the danger position, the circuit of the cautionary signal would be broken and that signal would also go to danger. The obvious reason for this is that as the home signal is the controlling signal, that when it indicates "Danger, stop!" the indication given by the other signal must, of course, be the same, or there would be at the entrance of the block two signals, one indicating "Danger, stop!" and the other "Safety, go ahead!" Breaking the signal circuit at this point does not cause both of the signals operated by the main battery of Block 3 to assume the danger position, as the two magnets operated by this current are in parallel and not in series; the current flowing from the battery through the contact points of the track-circuit relay, after which it is divided, one-half flowing through the magnet of the home signal, and the other half to the magnet of the cautionary signal. The circuit from each signal back to the battery is completed, either by a common return wire or by connections made with the ground, as is represented in the cut.

The signals at the entrance of Block 3 are shown at safety, indicating that not only is Block 3 clear, but that Block 4 is cleared also.

If we suppose the train to have moved up into Block 3, both signals governing the entrance of that block would go to danger, the home signal at the entrance of Block 2 and the cautionary signal of Block 1 changing to safety, while the cautionary signal of Block 2 would remain at danger.

From this description it is seen that a train is at all times protected by a stop signal immediately behind it, and a cautionary signal which is the distance of an entire block behind that one, to give warning to any following trains that a train is in the next succeeding block. This system has been in successful operation for a number of years, and is at present in use, to a greater or less extent, on the Pennsylvania, the Central of New Jersey, the Boston & Maine, the Chicago & Northwestern and other roads. Criticisms that have been made against the system are that the cost of installation is large, and that there is a possibility of the signal giving a wrong indication, from water freezing around the air valve in winter, due to a condensation of moisture upon the valve and in the passages when air was released from the cylinder. The manufacturers claim that this latter difficulty has been overcome, by providing better means of drying the air at the pumping station, by draining the reservoirs regularly of water, and by putting the cylinder inside of an iron pipe, which pipe is made to answer for signal pole, so that the parts are protected and will not become clogged with snow or ice.



DANGER. SAFETY.

Interior View of Hall Signal Case.

Passing on now to the Hall electric signal, we find, as has been previously stated, that it differs very widely from the ordinary semaphore signal, in that the indications are made by different colors and not by the position of a signal blade. The form and general appearance of this signal is shown in Fig. 8, the signal being represented as indicating safety. The view shown is one taken on the Chicago & Northwestern, the signal being put in between the two tracks, wherever possible, as the trains of that road run on the left-hand track. As will be seen by reference to the figure, the working parts are inclosed in a large box placed on the top of an iron pole, a large glass-covered opening being made in the box, behind which a colored disk is raised or lowered to give the different indications. A white glass exposed in the back of the case whenever the disk is raised, does away with the necessity of bringing a white disk in front of the opening for the safety indication, and serves also to illuminate the disk when same is brought in front of the opening. The case is painted black for the purpose of making a strong contrast with the red of the disk or the white of the background, and in this way make the indication more distinct and visible at a much greater distance than it would be otherwise. To distinguish a cautionary signal from a home signal, the case of the former is painted white, instead of black, so as to form a strong contrast with the disk, which is painted green in place of red, green being the color used to indicate caution, from its use as such for a night signal. Cautionary signals of this pattern are used in the same manner as with the semaphore signal, the two cases being arranged as shown in Fig. 9, the home signal being the one placed on top, or above the cautionary signal.

Two interior views of the signal case are shown in Fig. 10, the signal being represented in one case as at danger, and in the other at safety. It will be seen that the construction of this signal is exceedingly simple, consisting of a magnet supported on a suitable frame, which also acts as a bearing plate for the armature; of an armature made of special design, which, it is claimed, will lift a heavier weight with the same current than will any other form of armature; of two aluminum wire frames fastened to the armature, over the larger of which colored silk is stretched to give the danger indication, a piece of red glass being put in the other, which is brought in front of a lamp to give the same indication at night. The large disk being heavier than the small one, the signal moves to danger by the force of gravity. When, however, the magnet is energized, the disks are withdrawn from before the openings by the rotary movement of the armature, and a safety signal is given. The indications at night are made by a lamp placed behind the opening provided in the upper part of the case, as is shown in Fig. 11, the clear white light showing through

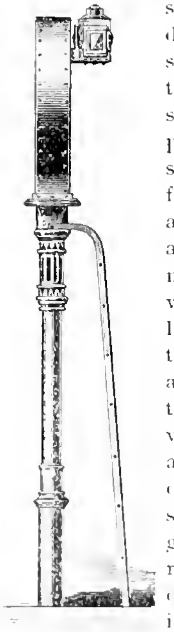


Fig. 11.
Side View.

if the signal is in the safety position, and red if it is at danger.

The circuits that are used with the pneumatic system can be used to operate this signal also, as the signal is held in the safety position by the signal circuit, the same as with the pneumatic. For, when there is a train in the block and the track relay is short-circuited, the armature will fall, breaking the signal circuit flowing through the signal magnet, and allowing the signal to go to danger by the force of gravity. The cautionary signal being connected with the track-circuit relay of the next succeeding block, in the same way as was shown with the pneumatic system, it will indicate to an approaching train whether that block is occupied or not.

The Hall system is in use on the Illinois Central, the Boston & Albany, the Chicago & Northwestern and many other railroads, the total number of signals in use being in the neighborhood of 1,500.

Very decided objections have been raised against this form of signal by many experienced railroad men, owing to its depending entirely on color, instead of position, for the different indications, they claiming that the impression made on trainmen is not a very decided one, and that the signal is not visible at a sufficiently great distance, except under the best conditions of weather, to allow an engineer to stop before passing the signal, should it be at danger. However, these are questions about which almost everyone will have a different opinion, and it must be left for the management of each road to settle in the way they think best.

Another objection is that wet snow will stick to the glass, and, by obscuring the signal, practically put it out of service just when a signal is most needed. Of all the automatic signals, the Hall is the surest in its workings and the easiest to keep in order, the times when it has been known to indicate "Clear" when such was not the fact being few and far between. This has occurred where the case has been defective, allowing water to leak in and saturate the cloth of the large disk. The electro-magnet is, then, not strong enough, when energized, to raise the disk, unless the counterbalance weight is adjusted further out on the arm of the small disk. Should the cloth dry out and the counterweight not be readjusted, the large disk will be overbalanced and the signal will be held at safety by gravity when the signal circuit is broken, thus giving a wrong indication.

Certain it is that one can hardly imagine anything simpler and less likely to get out of order than is this signal, for there is nothing touching the disk to catch or get out of adjustment, the power being applied direct by means of magnetic lines of force; there is no friction in the parts other than from one small shaft, and, by being inclosed in a case, the moving parts are protected from interference from any outside agency.

As this article is somewhat too long already, I will leave the description of several other systems to be given in my next paper.

Ideas Are Not Patentable.

One of the most common forms of robbery at the present day is the imitating and pirating of patented articles, the imitation becoming the marketed article, while the original remains in impoverished obscurity. This comes about generally by the party who had the enterprise to steal his neighbor's ideas, having also business enterprise sufficient to push the ill-gotten product upon the market.

We are perfectly aware how much injustice is done to real inventors by the pirates; but there is no doubt that many men consider themselves the original inventors of devices to which they have no claim whatever. One cannot have much intercourse with some men of an inventive turn without finding that all important inventions are claimed by parties who did not patent them. The universal inventor keeps saying, "That is my idea. I thought of it long before Edison did, and was working it into shape when he got it patented." The working it into shape is the real rub. Ideas are not inventions. A man may have an idea of a useful invention, and yet have no mechanical skill to work it out into practical shape.

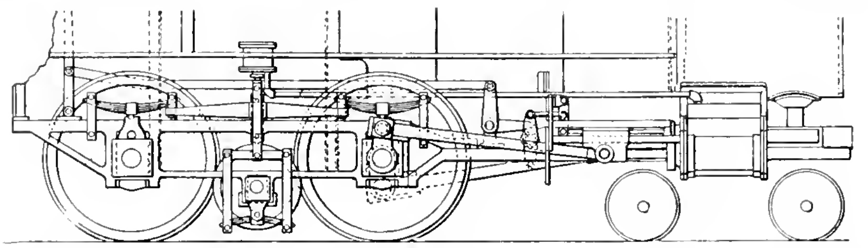
We had rather a curious experience once with a would-be inventor. He had been recommended to consult with us because, as he frankly expressed it, an editor's opinion did not cost anything. He had an idea in his head about a valve, but could not make it clear. We asked him to make a rough sketch, but he could not do that, and he appeared to have no idea of how to make a model. A few days afterward he came in with a very crude model made out of a big potato. The best we could do for him was to recommend a good patent attorney. Several years afterward, the same man came to us with a bitter complaint that a certain firm had put his valve on the market without asking his consent. Of course, he wanted us to denounce the injustice. On looking into the case we found that the valve was not anything like that which he patented. When this was explained, he insisted that we had sent him to an incompetent patent attorney, who failed "to catch on" to the idea of the inventor.

There are many cases of this kind. Men with vague ideas about an invention expect the patent attorney to do what would be the real inventing. The rule of the Patent Office is that an invention must be reduced to a practical form, either by the construction of the machine itself or of a model thereof, or by making a drawing of it, or by such disclosure of its exact character that a mechanic, or one skilled in the art to which it relates, can and does, from the description given, construct the improvement or model thereof. Unless this is done, there is no legal claim for the protection of letters patent.

A Novel Engine Design.

We show herewith outline sketch of a locomotive recently patented by Mr. Bernie Bulla, of the Southern Pacific Company, at Yuma, Arizona.

Mr. Bulla's engine is a four-cylinder compound, having a crank axle, and the usual outside cranks as well. This part of the design is not far different from several others except, perhaps, in the arrangement of the cranks. By placing the low-pressure



cranks slightly ahead of exactly opposite the high-pressure cranks, the low-pressure pistons will pass the centers ahead of the high-pressure pistons. This will allow less lap on the low pressure valve, thereby cutting off steam later in the stroke for the low pressure than for the high pressure, and avoiding excessive compression in the high-pressure cylinder when cutting off close.

The novel part of the engine is the method of driving the rear pair of wheels.

No side rods are employed, but an idler, in the shape of a friction wheel, or pair of wheels, is hung between the drivers, as shown. A spring keeps this pair of wheels down and out of contact with the wheels when the engine is shut off. When steam is admitted to the chests, it passes back through pipe shown to a small cylinder on each side of the engine that lifts the friction wheels up, and into contact with the drivers. This gets rid of the side rods and all their attendant ills. Does it introduce others?

At the recent Air Brakemen's Convention, at St. Louis, one member stated that the effective braking force of their passenger trains had been cut down 20 per cent. by the use of chilled brake shoes. They use the Lappin. The shoes last several times as long as gray iron castings, but they won't stop a train so quick or so well.

Standard Air-Brake Freight Levers.

BY B. HASKELL.*

The question of interchange of freight cars has been pretty well stirred up lately. This is an important matter, and I think it will be of benefit to railroads to keep it stirred until a general adoption of the Chicago plan is effected.

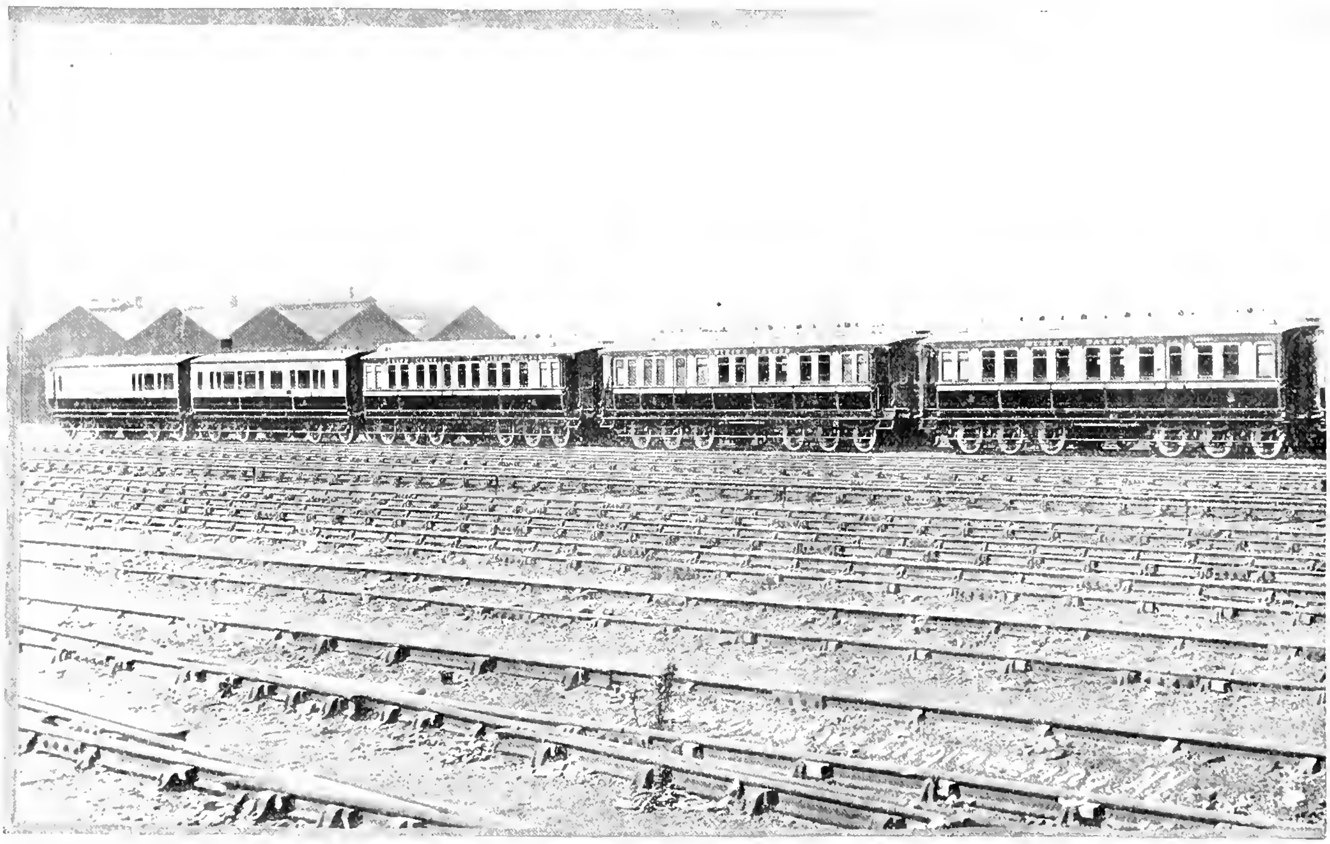
But if there is any one particular thing that does want stirring up, overhauling and straightening out at present, it is the question of brake levers on air-brake freight cars. I do not know of anything in connection with the freight-car equipment that is in a more mixed-up mess than the brake levers. It is a good thing the M. C. B. Association has taken the matter up, and it wants to be kept up until standard levers are adopted by the M. C. B. Association; and they ought to be adopted this year, for the reason that if it is allowed to go on another year, and the same plan is followed that is now being followed, there will be every conceivable size, proportion and style of lever on freight cars that it is possible for man to invent, as there will probably be a large number of brakes applied this year, or before the 1896 meeting of the M. C. B. Association. This is not a difficult matter to settle. The designing of a standard leverage for all weights of cars is a simple matter. I mean by standard leverage, a set of live, dead and cylinder levers that can be applied to any freight car weighing between 18,000 and 40,000 pounds—these to consist of four different size levers for cars using outside-hung brakes, and three different size levers for inside-hung brakes; and the standard 8-inch freight air-brake cylinder will do for all cars using these levers weighing between 18,000 and 40,000 pounds, with a minimum braking power of 70%, and a maximum braking power of 77% of light weight of car.

What are the conditions to-day? The following statement of the conditions of brake levers and braking power, which was found in a Grand Rapids freight yard on forty-three cars belonging to twenty-four different roads, will show. (See statement attached.) Here you will find twenty-nine different size live levers, twenty-six different size dead levers, thirty-six different size cylinder levers, and forty-two different size floating levers, and with a light-weight braking power ranging from 52% to 96%, and, figuring on marked capacity, a loaded-weight braking power ranging from 18.3% to 41%, cars weighing from 21,500 to 41,200 pounds. This statement, I think, is a fair representation of the existing conditions of brake levers all over the North American Continent. This does not show exact condition of affairs, as on some cars the live and dead levers were not of same dimensions, but in making up list only dimensions of levers on one truck were used.

In looking over this list you will find only five cars with the same size (8 x 24) live levers. There are four cars with 6 x 24, and four cars with 7 x 21 live levers. The balance, with the exception of eight cars, two of which have $8\frac{1}{2}$ x $23\frac{1}{2}$, two $8\frac{1}{2}$ x $25\frac{1}{2}$, two 9 x 22, and two 9 x $22\frac{1}{2}$, all have different sizes, ranging from 6 x 18 to $10\frac{1}{2}$ x $18\frac{1}{2}$. Dead levers are in about the same condition. As to cylinder levers, there are only four cars having the same levers (8 x 23). Two cars have $7\frac{1}{2}$ x $21\frac{1}{2}$, two have $8\frac{1}{2}$ x 23, two have 11 x 22, and two have 12 x 19 levers. I call this a pretty bad state of affairs, but the floating levers are in a worse mixed mess than the others; with the exception of two cars which have $4\frac{1}{2}$ x 13 levers, the balance all have different sizes, ranging from $4\frac{1}{2}$ x $12\frac{3}{4}$ to 13 x 33.

Imagine this state of affairs to exist with wheels, journals and bearings, draft timbers and M. C. B. couplers! I wonder if there wouldn't be some bad delays to freight? Note that there are twenty-nine cars braked under 70%, and twelve cars braked over 70%. There are, however, only five cars braked over 80%. It is not so bad to have cars braked over 70% as it is to have them braked below that proportion, from a safety standpoint. I do not consider there is much danger of slid wheels when braked between 70% and 80%. Passenger cars are braked at 90% and give no trouble with slid wheels. The maximum braking power of the cars in this list braked over 80% is only 41% when loaded to marked capacity, so I believe it is very important that none should be braked below 70% of weight of car.

* Supt. Motive Power, D., L. & N. and C. & W. M. Rys., Grand Rapids, Mich.



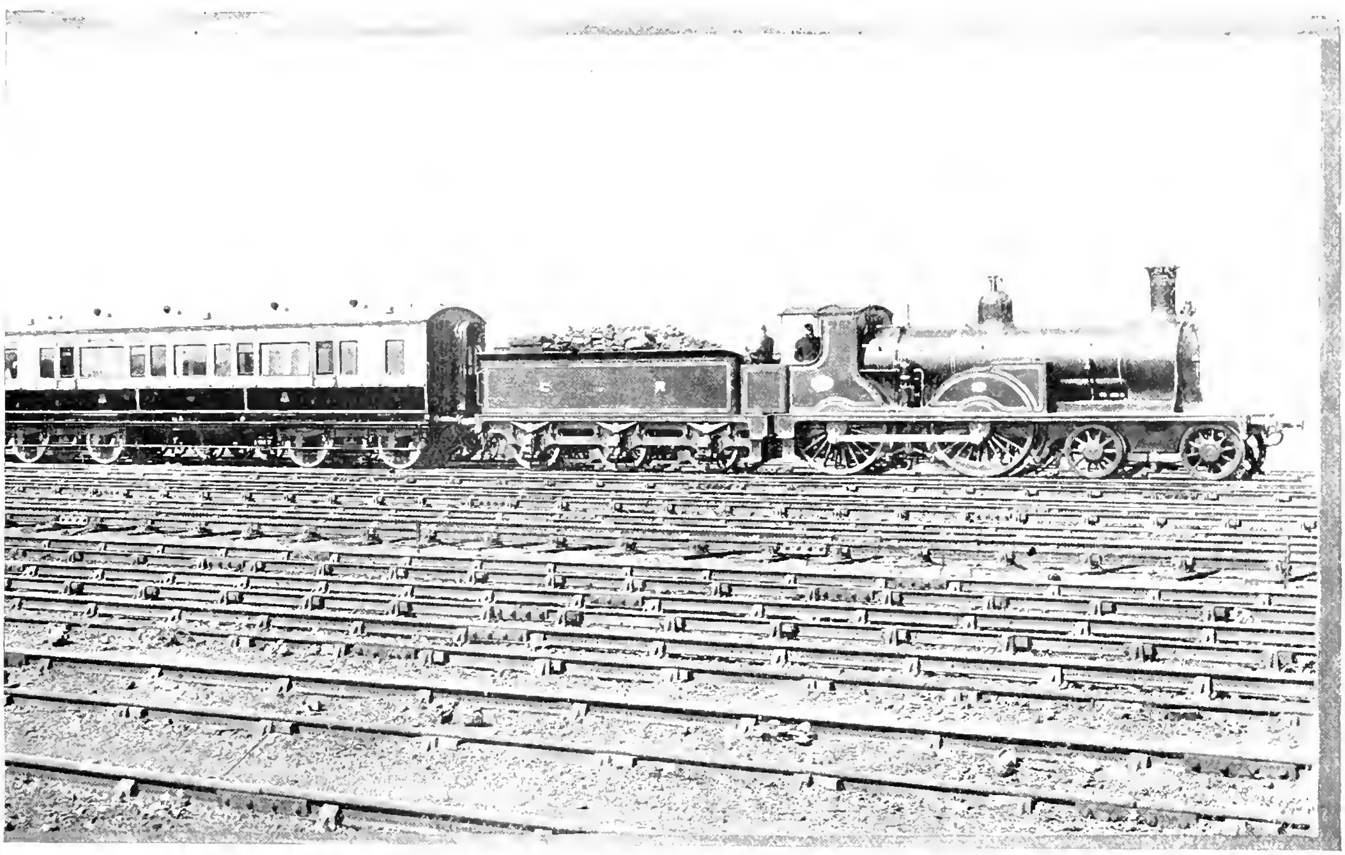
CALEDONIAN RAILROAD PASSENGER TRAIN.

Now, what worse condition of affairs can anyone imagine than this? Having such an excellent, reliable and wonderful device as the Westinghouse air brake for operating brakes, it is a shame and a disgrace to handicap it by using such a conglomeration of levers. To use slang, I think it must make the triple valves "tired" to be handicapped by such a mixed-up lot of assistants. There is more braking power to be derived from the hand brakes on some of these cars than there is from the air brake; not on account of any inefficiency of the operating part of the brake, but on account of the miserable distribution of power. Take a freight train of forty cars, with a range of braking power as shown in statement, and consider the effect of an "emergency" application as far as shocks to lading and strain to draft rigging are concerned. The low-braked car bangs against, and jerks on the heavy-braked car, and it is not to be wondered at that so many of our box cars have the ends knocked out and damaged. Shifting of loads caused by shocks does it, and I think the condition of the brakes is responsible for most of it. The M. C. B. Association objected to the brakes as used in the C., B. & Q. test, on account of the "shocks." The Westinghouse Company set about to overcome this; and now that they have done it, the M. C. B's are getting the same results they objected to at the C., B. & Q. test, by allowing this great variation of braking power. This condition of affairs accounts for the many break-in-twos that occur where the emergency brake is set.

I would like to ask some of the roads with grades as high as 225 feet per mile, what use the retainers are to them on cars braked below 70%. Of course, they will say they are having no trouble in this respect; but let them figure a little on the matter, and they will have to acknowledge that the retainers might as well be left off from some of their cars. As I understand this matter, the intended effect of the retainers is figured on a basis of a braking power of 70% of the light weight, with a retaining pressure of 15 pounds in retainers. This gives a certain effect at 70% braking power, but what is the effect where the braking power is reduced by leverage to 45% of light weight? I know of a lot of refrigerator cars with this braking power. The following will show:

Take a train of sixteen cars weighing 37,900 each on a grade of 116 feet per mile. Weight of the sixteen cars is 606,400 pounds; weight of engine, 150,000 pounds; weight of tender, 77,600 pounds; and caboose, 32,400 pounds, giving a total of 866,400: 45% braking power will equal 390,480 pounds braking force with emergency application, or 340,349 pounds with service application; and with a pressure of fifteen pounds in retainers, we would get a retaining force of 4,332 per car, and for seventeen cars 73,644 pounds, equal to 8.5% of light weight; and with a load of 44,000 pounds per car, a retaining force of only 4.6%; while if a train was braked on a 70% basis, we would get a retaining force of 8.5% loaded and 15.6% empty, or nearly double that of a 45% braking power. This train is supposed to have a 45% leverage on all sixteen cars. This might not occur often, but it is possible for it to occur, and I believe now that the variation in braking power is the cause of the many complaints I have heard from engineers that "retainers did not seem to hold, and I had to use the water brake when I recharged."

One can see by this that the decrease of braking power, by using improper levers, makes the service of the retainers of very little help and much below what they are designed to give. No matter what the braking power is, as long as it is not over 70% the holding power of brakes with retainers up should not be reduced or trifled with. If the braking power is reduced below 70%, the power of retainers should be increased, as they are needed more with a braking power less than 70% than they are with one of that proportion. I have known brakemen to set the hand brakes instead of using the retainers, their reason for this being that "retainers did not hold," and some engineers encouraged this for the same reason. I made a test in 1892 with a car braked at 45% and at 67%, to see what effect the two braking powers had on holding power of retainers. Brakes on engine were cut-out. After reaching a speed of twenty miles per hour (taken



SHOWING FINE EXAMPLE OF TRACKS, BULL-HEAD RAILS.

from a Boyer speed recorder) the emergency application was made at a marked point and quickly released, and the train ran 965 feet from point of release to stopping point. This was done with a 45% braking power, and repeated several times with the same result. Brake levers were then changed to give a 67% braking power, and test repeated several times, and the train ran 363 feet from point of release to stopping point—a reduction of 602 feet. This shows what effect a reduction of braking power by leverage has on the efficiency of retainers.

Take a train made up of the cars measured in Grand Rapids yard. If an accident should occur to it and an air-brake expert should be called upon to say in what distance a stop ought to be made with it, where is there an expert that that the trains used in the test were not loaded. I believe it would be an excellent idea for a test of this kind to be made by the Westinghouse Air Brake Company, and I think the results would be accepted by railroad companies as authority.

Referring again to the condition of levers measured on cars at Grand Rapids, inspectors are required to use considerable time and judgment in looking out for defects on, and after the safety of the cars. It is a credit to them that they overlook such few cases, but what show have they got, and what simple, intelligible rules are they furnished with to enable them to quickly and intelligently determine what levers an air-brake car requires? I have never found out that they had any. The M. C. B. rules do not refer to them, and very few roads do. Simplicity in instructions of this kind is what is needed, and the most simple way I know of is to stencil truck levers on the trucks, and cylinder levers on the body of the car immediately over their location. Anyone can tell then at a glance what is required, and the inspectors do not have to go and read over a lot of letters and circulars, or consult blueprints. I have followed this plan on passenger cars, and it worked to perfection. In addition to this I have the weight of all passenger equipment stenciled on needle beam, so by referring to chart it can be seen if cars are stenciled right. I use the same size truck and cylinder levers on all passenger equipment, ranging in weight from 32,000 pounds to 62,744 pounds. On cars weighing over 62,744 pounds I use the same levers, with a 14-in. cylinder in place of a 10-in. cylinder. None of the cars are braked over 90%, and none of them less than 82%. The system I have adopted for passenger cars was illustrated in the LOCOMOTIVE ENGINEERING of June, 1894, No. 6, Vol. VII, page 194. It has worked well, and we are not troubled with brakes not holding, or trains running by stations; neither are we troubled with any wrong levers being applied. I expect to illustrate a similar plan next month for freight cars.

CONDITION OF BRAKE LEVERS ON CARS EXAMINED IN GRAND RAPIDS YARD.

Car Numbers	Live Levers.	Dead Levers.	Cylinder Levers.	Floating Levers.	Light Weight.	Percentage of Brake Power to Empty Weight.	Capacity.	Percentage of Brake Power to Loaded Weight.
	in. in.	in. in.	in. in.	in. in	lbs.		lbs.	
22458	6 x27	5½x24½	8 x23	5 x15	31,600	73.	60,000	24.8
5572	9 x22	8¼x20	7 x20½	6½x18½	23,500	61.6	30,000	26.6
28289	9 x22	8 x20	9 x18½	8 x17	3[illegible],700	57.5	60,000	19.04
16127	9 x22½	8¼x20	11 x16½	10 x15	41,200	62.5	40,000	31.4
1692	8¼x18½	7¼x17	11 x22	6 x12	24,650	65.6	60,000	21.7
1740	8 x18½	7½x17	10¾x22½	6 x12¼	24,000	64	60,000	21
1982	8½x19	7½x17	11 x22	6 x12½	31,600	61.	60,000	21.
12690	8 x24	6 x18	8½x23	6½x17½	25,300	59.2	60,000	19.7
2955	8 x19	7½x17	9¼x21	6 x20	21,500	82	60,000	21.
1539	7 x21	6 x18	8 x23¼	4½x13	30,000	55.1	60,000	18.3
1822	6½x21	5¾x18	8 x23	4½x12¾	30,000	59.3	60,000	19.7
7010	7¼x21	6 x18	8 x23	4½x13	27,700	58.9	45,000	22.3
21043	7 x21	6 x18	8 x23	4¾x12¾	29,800	57.4	60,000	19.
23450	8 x24	7 x21	9½x24½	13 x33	26,400	70.9	60,000	21.6
74018	6 x24	6 x24	7½x21½	7¼x21	30,000	69.4	60,000	23.1
10449	7 x18½	6½x16½	9½x19	9½x16	38,000	60.8	60,000	23.5
4449	6½x24	6½x22	8¼x22	8¼x22	29,600	71.	50,000	26.
3198	9½x17½	9½x17½	12½x19	10 x14¾	3[illegible],350	67.7	50,000	34
3542	6 x24	6 x24	8½x20½	9½x28	27,040	70.9	60,000	22
14460	7 x21	6 x18	8 x22	6¼x17¾	25,400	67.7	60,000	21.
10354	8½x23½	8 x15	6½x18	6 x18	30,400	52.	40,000	22.
6167	7½x20	6 x15	8¾x19	7½x17½	31,200	63.3	30,000	32.
19	8½x34	8 x24	8 x17	11 x15	38,800	84	40,000	41.
Nil	8 x24	7 x20	12¾x24	10 x18½	27,350	93.	50,000	33.
32033	8 x32	7 x19¾	12½x24¾	10 x19	27,425	89.	50,000	31.
33433	8½x23½	7 x20	13¼x23¾	10½x18½	26,100	96.	50,000	33.
Nil	9 x19½	8 x16¼	12 x19	5¼x 8	32,400	74.9	60,000	20.6
78[illegible]	9½x19	8 x16	12 x19	5 x 8	32,458	69.8	60,000	24.5
65365	9 x22½	8 x20	10½x24½	5 x12	26,000	64	50,000	21.9
8848	8¼x23½	7 x20	15½x21½	11½x16¾	36,050	7[illegible]	40,000	33.
4517	9½x27½	8½x22	12½x23½	12½x23½	38,850	63.9	40,000	31.5
2607	8½x25½	7 x22	7 x19¼	7 x19¼	27,400	63.6	50,000	22.5
1289	6 x24	6 x24	7½x21½	7½x21½	27,000	75.	60,000	20.6
62524	8 x24	6 x18	8¾x21¼	6 x14½	31,300	63.	60,000	21.
8293	8½x25½	7½x21	10½x24	5½x12½	31,[illegible]70	65.8	60,000	22.8
10436	9¼x21¾	7 x17½	12½x21	7½x13½	28,450	80.	40,000	33.
60103	10½x18½	10½x18½	13 x21	8½x13	31,800	65.1	50,000	25.5
4170	6 x24	6 x24	9 x28½	6½x17	30,200	67.4	50,000	25.4
41243	7¼x21¼	7¼x21¼	12½x25	8¼x15¾	38,300	63.3	60,000	24.7
[illegible]	7 x21	7 x21	10 x19¾	8¼x16¾	37,600	63.3	50,000	27.2
[illegible]	6 x18	6 x18	[illegible]	[illegible]	[illegible]	50	60,000	21
[illegible]	9¼x25¼	6¼x16¾	[illegible]	[illegible]	34,150	7[illegible].	60,000	25.
[illegible]	[illegible] x24	6 x18	7½x1[illegible]½	7½x1[illegible]½	[illegible]	61	50,000	23.

could say? He might be able to say if he knew the braking power was 70%, but he could not with a train like this.

I believe that engineers are often blamed for making poor stops, when, if the brake leverage was looked into, it would be found that they did very well. This reminds me that there is something needed badly in this line, and that is, a thorough test to determine in what distance a *loaded* train of standard braking power ought to be stopped. Some figures that can be given as authority are needed. Of course, the New York Central test in 1892 showed what could be done with an empty train, but these figures cannot be accepted for a loaded train, and I think it was a mistake

The Air Brakeman's Nightmare.

A member of the Air Brakemen's Association, after attending a busy session at the recent meeting in St. Louis, and later on participating in a sparring bout in the committee rooms of the Lindell Hotel, had a novel nightmare, which he related to the boys, as follows:

You see [he began] being fatigued with the work of yesterday's session, and after supper topping off with a bout with the gloves in the committee rooms, I went to bed in a fit state to have a nightmare fully eighteen hands high. I tossed about for a considerable time after retiring before I finally dropped to sleep. I dreamed I was again at the Westinghouse Air Brake Company's works at Pittsburgh, which I visited coming out here. I dreamed I was walking through the machine shops, watching the machines and air-brake fixtures assume various and fantastic contortions, when I heard a tumultuous noise coming from the laboratory. Upon proceeding thither, I discovered the various air-brake fixtures grouped about a 24-foot ring and preparations being made for a prize fight. My sudden appearance was greeted with looks askance from each member of the entire party. A special driver-brake Triple Valve, Twelve-Inch Cylinder and Sixteen by Thirty-three Auxiliary Reservoir waited upon me, and demanded to know why this intrusion. I explained that I was a member of the Air Brakemen's Association and was seeking knowledge, and accidentally stumbled upon their party. "In that event, you are welcome," said the Triple Valve, "for we feel that the better we are understood the better we are liked."

"We are going to have a finish fight for the World's Championship to-night, between the Eight-Inch Air Pump, the middle-weight champion, and the Nine and One-Half Inch, the heavy-weight champion, which I feel sure you will enjoy."

I was given a seat and directed to be quiet, else prompt and forcible ejectment would be my lot.

Around the ring were grouped the various air-brake fixtures, awaiting the appearance of the principals and meanwhile discussing the coming fight. "Eight Inch will win in a canter," declared the Plate B11 Brake

Valve, who sat beside the Plain Triple Valve, back of Eight Inch's corner and across the ring from me. "Not on yer life," vociferously retorted the Hose Coupling, who sat beside me. "One stroke of the big fellow's piston will blow Mr. Eight Inch as far out of sight as the *Reina Regente* is at present."

"Eight Inch will break the floor with the big fellow's carcass," asserted the Plain Triple Valve. "He is so quick he can land when, where, and as often as he pleases."

"Nicht!" quickly interjected the Main Reservoir Drain Plug. "Ten to seven the big fellow wins!"

"Nonsense!" replied the Plain Triple, "why, on form——"

"Form be blowed!" interrupted the Drain Plug, "Long Green talks. Put up de dust, or else shut up!"

"If you fellows only knew Eight Inch as well as——"

"We ain't no Rubes!" chorused the Drain Plug and Hose Coupling. "If yer has any of de rapidly decreasing gold surplus about yer person to back your opinion wid, yer keeps de same very successfully concealed," added the Hose Coupling.

"You would think them low-down fellows knowed all about it, and was dead game sports, to hear them talk," sneeringly remarked the Straight-Air Governor to a group close by.

"What's dat you say about bein' low down?" demanded the Drain Plug, overhearing the uncomplimentary reference to himself. "Understand, you buzzin' crank uv antickity, dat I knows my biz, and kin do it. You can't do nothin' but buzz. Dere is a $5 rebate on you; your opinion is below par. Come over on dis side of de ring an' I'll give yer a punch where Trilby wore de beads." This was too much for the Ancient Regulator, and he wisely lapsed into submissive silence.

"Gentlemen, gentlemen," exhorted the Pressure Retainer, "pray contain yourselves, else Mr. Westinghouse will discover us, and will stop the whole thing. I have an endless amount of bent handles, leaky plugs and loose weights to back Eight Inch if any one will kindly give me odds of 10 to 7. I don't know much about fighting, but judging from the number of dints in Eight Inch's head, received from the coal picks and hard hammers, I believe he can stand some very hard knocks. I, myself, while not claiming to be a fighter, have had more hard blows on the side of the head from coupling pins in the hands of ignorant trainmen, and all on account of Triple Valve's trouble, than any one amongst you. Furthermore, I have been frequently kidnapped and cast into Hebrew bondage, and later made to walk as did Shadrach, Meshach and Abednego in the fiery furnace."

"What firm is dat de guy's talkin' about?" inquired the Drain Plug of the Hose Coupling.

"'Tain't no firm," replied Hose Coupling, "Dem's scripter fellers."

"As Rudyard Kipling says——," attempted the Pressure Retainer, but was instantly called down by the crowd, who objected to anything not directly pertaining to the all-absorbing topic.

"Is Rud-what-duz-yer-call-'im another uv them scripter fellers, Cuppy?"

"Naw; him and Oscar Wilde is main guys in de Three Hundred and Ninety-Nine," scornfully replied the Hose Coupling, evidently disgusted with the Drain Plug's lack of knowledge concerning Holy Writ and New York society.

At this juncture enthusiastic cheers greeted the appearance of the Eight-Inch Pump, as he stepped through the ropes and walked to his corner with his characteristic quick, snappy step. He looked in the pink of condition as he sat smiling and nodding to familiar faces grouped about the ring. His jacket and number plate were neatly polished, and around the piston rod, between the gland nuts, he wore his colors, a brand new white cotton wicking swab.

"Trained to the minute, yet I fear this new heavy-weight champion will defeat him," remarked the Ten-Inch Brake Cylinder.

The admiration excited by the appearance of the Eight Inch had scarcely died away when the Nine and a Half Inch made his appearance. As he assumed an upright position after stepping lightly through the ropes, and passed to his corner with a light step, his symmetrical form and greater bulk called forth flattering praise from even the Eight Inch constituency. His jacket and number plate were also neatly polished, and he wore a tight-fitting swab about his piston rod which filled the space to perfection between the brightly polished gland nuts.

He cast a glance towards the opposite corner, which was caught by Eight Inch, and returned with a smile. Nine and a Half also smiled; but it was one which boded no good to the plucky little Nonpariel, who sat so calmly in his corner, and who was going out of his class in quest of greater honors. Each pump seemed to be in excellent condition, and a good contest thus assured.

While the seconds worked with their principals, and sundry opinions were being exchanged as to who would be the winner, an old antiquated air pump of the "flint lock" or "trigger" pattern came hobbling and staggering from the darkness into the light, and joined the group in which the Three-Way Cock and Straight-Air Governor were.

"Hello, Methusaler!" piped the irreverent Drain Plug, spying the old fellow. "Yer guy de scrap pile de shake ter grace de canyvall wid yer presence, did yer?"

The old fellow essayed a reply, but was evidently unequal to the effort.

"Sh! Quiet!" urged the Fourteen-Inch Brake Cylinder. "He's going to say something."

After shaking the dust and accumulation of years from his coat, the Ancient Compressor succeeded in making a partial stroke, and then stopped.

"Rap de old guy on de nut wid a coal pick; dat'll start 'im," suggested the Drain Plug.

Copious applications of oil to the valve motion and piston rod finally got the old pump into motion.

"Silence!" demanded several voices from all sides of the ring.

"Yes; be quiet, and let Rip Van Winkle sputter," added the irrepressible Drain Plug.

"Air pumps nowadays are nothing as compared to what they used to be in the good old palmy days," feebly piped the old fellow, in an asthmatic voice.

"Listen to de Chinaman!" interjected the Hose Coupling. "I reckon ye could prove it by old Bill Jones, if he was alive, hey?"

T. W. Cock and S. A. Governor tenderly brushed the cobwebs and dirt from the packing nuts and rusty piston rod of the old pump, as they assured him in kindly whispers of their everlasting allegiance and support, and encouraged him to speak further, that they might again hear his beloved voice. After several attempts to regain his breath, he continued:

"You fellows don't know a good pump when you see it. I have come to challenge the winner of this fi——" Here a fit of coughing interrupted further speech from the old "flint lock."

"Don't know a good pump when we sees it. Air pumps are not what they used to be," mused the Hose Coupling. "I reckon Old Whiskers first started de fad of Kansas cyclones and Dakota blizzards. I remember hearin' tell of an injineer on the Southern Pacific Road askin' de master mechanic to move de air pump from de right side uv de injun to de left, as he said he believed de pump made de air thin, and made it hard fur him to breathe, fur he had de asthmy. I wonder if Old Whiskers wuzzunt de cause uv de complaint? Now dat I stop to think, I wonder if Old Whiskers isn't guilty uv makin' de air thin up around Marshall Pass?"

After recovering from the fit of coughing, the old fellow continued: "I will fight the winner at catchweights. I will fight the fight of my life. I know he will say I am not in his class, but I will show him what pumping is, and will prove to his satisfaction that the art is fast becoming lost. I will need no training further than a little lye water run through my air valves and cylinder, and a little oil on my valve motion and in my steam cylinder. It is true that Eight Inch knocked me out in former years, but it was by a chance blow, through my packing, as I had not been taking very good care of myself, having indulged in too much oil through my air valves, and had been living a rather

high life upon the Denver & Rio Gr——" A severe fit of coughing again attacked the old veteran, which caused much apprehension on the part of T. W. Cock and S. A. Governor. Before their beloved champion could recover, the voice of Referee Main Reservoir was heard calling the audience to order. The tumult ceased. The loquacious Drain Plug even became attentive, and urged others about him to do likewise.

"Gentlemen," began the referee, "to-night's fight will be to a finish, for the heavy-weight air-pump championship of the world,'steen thousand dollars a side and the diamond-studded (Brady) silken swab, between Mr. Eight-Inch Air Pump, the middle-weight champion (cheers), and Mr. Nine and a Half Air Pump, the heavy-weight champion" (cheers). Both principals bowed their acknowledgments of the introduction, and resumed their seats. "The seconds for Mr. Eight Inch will be Plate D8 Brake Valve, Whistle Signaling Valve and Plate D9 Governor, while Plate E6 Brake Valve, Pressure Reducer and Plate E7 Governor will act in the same capacity for Mr. Nine and a Half Inch. Messrs. Single Pointer and Duplex Air Gauges will keep time. The pivot blow will be barred. The audience is particularly requested to remain quiet, as any undue noise may attract Mr. Westinghouse's attention and cause him to stop the contest."

"Dat last part de foxy old duck said wuz stuff," whispered the Drain Plug, "for Mr. Westinghouse, when seconded by Christy, Bell and Betts, is a top-notcher knocker-out hisself, and wouldn't turn us down fur havin' a little fun here in the laboratory."

"Shake hands, gentlemen!" sharply demanded the referee of the principals, who advanced, with smiles on their faces, to the center of the ring, and complied with the usual formality. Mr. Eight Inch elevated his elbow on a line with his shoulder, and prepared to give the society wiggle of the fingers, but Mr. Nine and a Half shattered his attempt at the fad by giving a decided Otto Best hand shake. The best of feeling seemed to exist between the two men. "May the best man win," smilingly said the Eight Inch. "My sentiments exactly," replied the Nine and a Half, returning the smile.

For a few moments the seconds for both principals applied themselves vigorously to rubbing and fanning their men, while the Drain Plug and Hose Coupling were overheard remarking something about dollars and doughnuts and getting into an orchard, etc.

"Time!" clanged the gong.

Both principals sprang quickly to the center of the ring, while the seconds, taking chairs, bottles, sponges and towels with them, retreated through the ropes to the outside of the ring, and nervously watched the cat-like movements of the two men in the center as they indulged in the preliminary fiddling, with a view of getting the other's measure. The throttles of both pumps were but lightly opened, working the water off and accumulating a little pressure for cushion. Eight Inch led with his left, and lightly landed on his opponent's wind, but got in return a hard right-handed counter on the edge of his steam cylinder head. A left-hand swing was cleverly ducked by Nine and a Half. A left-hand feint and upper cut with the right failed to entrap the big fellow into ducking. Eight Inch received a stiff left-hand jab in the wind, right on his number plate. "Hully gee!" exclaimed the D9 Governor, "it's lucky for Eighty that he has no diaphragm in his stomach like I have, or that blow would have cracked it." The principals were exchanging pleasantries and sparring lightly when the gong sent them to their corners.

At the call of time, both men advanced quickly to the center of the ring for the second round. Nine and a Half assumed the aggressive, flooring the middle weight with a clean left-hand punch on the cap nut. Upon regaining his feet, he was again sent to grass by a terrific right-hand swing, which landed on his steam-exhaust connection. He was evidently dazed, and awaited the full time allowed before rising. Nine and a Half now set up a hurricane pace, which the Nonpareil seemed unable to resist. The round ended with Eight Inch in his corner, nearly to the ropes, and the big fellow using his head for a punching bag. Eight Inch was unmistakably groggy.

The third round found Eight Inch considerably recuperated. His lubricator was feeding faster, and the throttle was wide open. Nine and a Half was running on about a half throttle, making long, regular strokes, and his lubricator was feeding leisurely. Little time was lost in sparring. Eight Inch led for the wind, but fell away short. He then tried one of his famous clear across the ring rushes, but was neatly stopped. He was evidently much distressed at his inability to land effectively. He succeeded in landing lightly on the big fellow's air strainer, but received in return a terrific right-hand counter square on the steam cylinder, which tore a hole in his jacket, and carried away a part of the lagging. He was barely able to rise, but did so in time, only to meet Nine and a Half, who had borne down on him like a hawk. The sounding of the gong saved him. His seconds rushed to the center, and carried him to his corner.

"Give him some valve oil through his air valves," volunteered the Flint Lock. "An engineer on the Erie years ago used to give me a half pint regularly each day, and told me it did me good."

"Don't do it!" bellowed the Air Hose. "I get enough of that to know that it shortens one's life."

"Time!" clanged the gong.

Eight Inch led for the air strainer, but again fell short. He quickly tried for Nine and a Half's steam-exhaust connection, but, missing, clinched. In the breakaway, Eight Inch sent his right with all his force for the edge of the big fellow's steam cylinder head, which was cleverly ducked, and the force of the middleweight's blow carried him to the floor. Nine and a Half kindly assisted him to arise, which act was loudly applauded. "Better throw up the sponge, little Nonpariel," suggested Nine and a Half. "Never!" returned Eight Inch. "I'll have to knock you out, then," said the big fellow, and proceeded to keep his word. He no longer feared the middleweight's blows, and aiming a left-hander at the cap nut, almost tore the cylinder-head bolts from their places. A right-hand swing on the damaged jacket sent the Eight Inch to the floor, where he was counted out by the referee. As he tenderly lifted him in his arms, and carried him to his corner, the big fellow murmured in a voice inaudible to others than myself around the ring side, "Game as a pebble, quick as a flash, brave as a lion, and cruel as a tiger, but out of his class."

E6 Brake Valve and E7 Governor wrung the gloved hands of the champion, and exclaimed: "We are the *fin de siecle* people."

Eight Inch came to shortly, and hastened to congratulate the winner on his victory, and assured him it was fairly and cleverly won.

The old Flint Lock was pressing forward to make a match with the champion, saying T. W. Cock and S. A. Governor would back him, but the scene changed; the ring and audience disappeared, and in their stead was a locomotive, which I was running. Red-headed triple valves were chasing a brake valve dressed in pajamas over the headlight and around the smokestack. A 9½-inch air pump stood calmly by, dressed in a plug hat and dress suit. The clang of the Washington street trolley car bells wakened me. You can bet I am going to bed to-night to sleep. Those fellows up in the committee room can spar as long as they please. I want to rest. I don't want to see the ghost of old Flint Lock to-night sitting upon a brake wheel, calling on me to try my air.

A correspondent in St. Paul sends us a statement of lubricating oils used on the Chicago, St. Paul, Minneapolis & Omaha. From this statement we find that 34.54 miles are made per pint of engine oil, and 98.03 miles per pint of cylinder oil. The average cost per 1,000 miles run was $1.73. Our correspondent says "Mr. Ellis, superintendent of machinery, has under his charge 255 engines. The divisions are quite long, grades very high, they are sandy, and high speed is maintained. If you compare our performance with that of other roads, you will see that it is something to be proud of."

We will send a good, cheap binder for 25 cents—holds a year's numbers.

Cutting Screw Threads on a Lathe.

The following plain and practical directions for cutting screw threads on a lathe, and for figuring the gears to be used, were contributed by Mr. J. E. McConnell to the *American Machinist:*

To determine what gears to use, take the numbers of threads to the inch which the lathe will cut with even gears—that is, gears of same size on stud and screw—for the number to be used on stud, and take the number of threads per inch desired to be cut, for the number to be used on screw, or any other numbers which are in the same proportions to each other as these two. For instance, the lathe cuts three threads per inch with even gears, and we desire to cut seven. To do this, we use gears on stud and screw which are in the proportion to each other that 3 is to 7, as 18 : 42, 24 : 56, 30 : 70, 36 : 84, and so on.

When the stud makes the same number of revolutions as the spindle, which is the case with most lathes, the lathe will, with even gears, cut screws of the same pitch as the lead screw.

In cutting a double-threaded screw, it is best to change alternately from one thread to the other, if convenient, especially with the finishing cut. This can be done by opening the nut and moving the carriage, or turning the lathe so as to bring the point of the tool in the other thread, provided the pitch of the screw on work in the lathe is an even number of times greater than the pitch of the lead screw, as 2, 4, 6, etc., times.

Or it may be accomplished by disconnecting immediately below the gear on stud, and turning the lathe, together with the stud, one-half revolution, and placing the gears again in mesh.

It is well to chalk two teeth which bear against each other before disconnecting, and mark a tooth on the stud directly opposite the first mark, so that there may be no trouble in changing one-half revolution. Should the stud and spindle not revolve at the same speed, it is the spindle which must be turned one-half revolution, letting the stud revolve as far as it may.

In cutting a thread on a lathe which is without a reversing belt, and where the vent will not drop into the lead screw at every point and correspond with the work, the following is a safe practice:

When the tool has run sufficiently far beyond the end of the thread for clearance, stop the lathe and make a chalk mark on shears of lathe opposite a corner projection, or mark on carriage. Make another lathe somewhat further back than the length of the screw on work. The distance between the marks must be the shortest distance, or multiple of the same which will contain a whole number of threads on lead screw and a whole number of the threads on work. Open the nut and move the carriage back to the latter mark; close the nut and go ahead, stopping lathe again at former mark, and repeat.

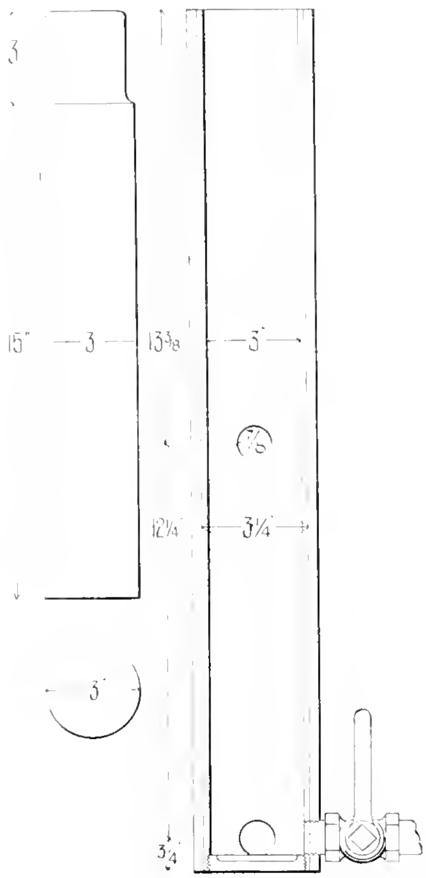
Example: We have a four-thread lead screw lathe and no backing belt. We want to cut eleven and one-third threads to fit 2-inch gas pipe. In this case, after stopping the lathe, we move the carriage back 3 inches, which will contain exactly twelve threads on lead screw and thirty-four threads on work in the lathe.

An Air Hammer.

The sketch shown herewith will serve to explain the simple construction of an air hammer, made by C. F. Thomas, master mechanic of the Southern Railway, at Alexandria, Va.

Mr. Thomas wanted a "gun" for removing frame bolts, and experimented with air with the best of results.

The gun is simply a copper tube with a



bottom fitted into it, and an air-hose connection at the bottom. The "valve motion" consists of two holes, one at the bottom and one 12 inches above it.

A 3-inch plunger or piston is made to fit the gun nicely, this plunger being a little more than half the length of the tube.

When placed under a bolt or other part to be driven, care is taken to block it up near enough to prevent the plunger from being thrown out of the tube, and low enough so that bottom of plunger will come above top hole.

The bottom hole prevents the plunger from being stuck without chance of relief below the exhaust hole.

When air is turned on to this device, the plunger makes a sharp jump, striking the bolt; the air partially escapes at the top exhaust hole, and the plunger is thrown back by recoil against the air, which, receiving re-enforcements all the time, again throws it up. The length of the stroke and the rapidity of the blows are governed entirely by the amount of air admitted. When running fast, the blows are so rapid as to sound like a rattle.

This hammer will work at an angle of about 45 degrees. It can be placed under engine frames, or other places where it is hard to get in a blow with a hand hammer, and it is wonderfully effective in starting refractory bolts.

Experience With Steel Driving Boxes.

Sometimes there is a general belief about something mechanical that gets to be a belief because someone said so, or it is figured out from a wrong basis. Now, when it is suggested that steel driving boxes be used, the average railroad mechanic will say, "All right, but you will have to face the box with soft metal or the steel will wear the hub bad." Perhaps the man making this remark never saw a steel driving box—but he has heard, and believes, the cutting story.

Three years ago the Dixon Locomotive Works at Scranton, Pa., built some heavy moguls for the New York, Ontario & Western road, and used steel boxes, letting the bare metal run against the hub of the wheel. These engines have been in heavy fast service ever since, and have never had hot boxes. The two first were recently in the shop for minor repairs, and the wear on hubs and boxes is scarcely perceptible—tool marks yet to be seen. One of the engines has run 86,771 miles, and the other 72,952 miles. If you really want to know what will happen with an untried device, the best way in the world is to try it.

Afraid of Getting Pinched.

"We used to have a master mechanic," observed the Wolverine delegate, "who never had anything to do with railroads or locomotives until he came to us. We had a little road, and the master mechanic did most of the repairing. Our official head was a handy, all-round man—one of them saw-mill chaps that can do anything. One day he was in the firebox of the "2," calking her flues with a cape chisel and soft hammer, when the fireman came to the engine to clean up.

"He heard the old man tinkering around, but didn't notice where he was, so he got up in the gangway and sang out:

"'Look out for your fingers, Mr. Smith, I'm going to reverse her!'

"'Whope!' yelled the master mechanic, making a dive for the fire-door, 'wait a minnit, Jimmie,' said he, as he crawled out on the deck, 'all right, sonny, pull her over now—it's a good thing ye sung out. Allus say something afore ye reverse her, ye might cripple me up for life.'"

LOCOMOTIVE ENGINEERING
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Smoke Prevention.

When we watch the common spectacle of a smokestack pouring out volumes of black smoke, the immediate impression is that the sight represents a shameful waste of fuel. A person with even very elementary knowledge of the principles of combustion, gets mentally to figuring on the volume of uncombined carbon that is passing away to pollute the atmosphere, and it does not require much calculation to estimate the potential heat units that are wasted. Experience may afterwards prove that the waste is more apparent than real.

The smoke nuisance is no new bone of contention between health authorities and owners of boilers and furnaces. There has been a conflict going on between these two interests almost since steam boilers were first used. About eighty years ago, a Smoke Committee was appointed by the British House of Commons, to try and devise means for reducing the smoke nuisance, which was declared to be beyond endurance, a menace to health, and ruinous to the appearance of public buildings. The committee made a very searching investigation, and all the resources of science and inventive genius were called upon to provide the necessary remedies. The call for remedies brought forth a bountiful crop of smoke-consuming appliances, and the growth of this species of invention has never entirely ceased up to the present time; but the smoke nuisance, like the poor, is always with us.

The investigation made by the British Parliament was by no means the first effort made to prevent the generation of smoke in the burning of bituminous coal. The first attempts to design a successful steam engine were carried on by scientific men, who did not fail to perceive the necessity for restraining the formation of smoke in their furnaces. About 200 years ago Denys Pepin, a French philosopher and inventor of numerous steam apparatus, invented a smoke-consuming furnace on the downward draft principle which is still claimed as a novelty by unexpired patents. The first smoke-preventing device to receive much practical application was invented by James Watt in 1785. He burned the fuel on a brick hearth like those now used for melting iron on what is called open-hearth furnaces. The air for maintaining combustion was forced by a fan upon the top of the fire. This did not work well with coking coal, and the plan was adopted of supporting the fire on grate bars, with a dead plate near the door. The fresh fuel was coked on the dead plate, then pushed forward upon the grate bars. The incandescent fuel in the front consumed the smoke that rose from the fresh fuel. Many modifications of this plan have been tried, some of them on locomotives. When they first began to try burning coal in locomotive fireboxes in Britain, about 1837, a "midfeather," or water space, was run across the middle of the firebox, reaching up to about the level of the lower ring of the fire door. Coal was burned in the back apartment and coke in the front. The hot gases of the coke consumed the smoke that passed from the coal. It was very wasteful of heat, as the process converted the carbonic acid products of the coal into carbonic oxide. The effect of this will be understood when we remember that a pound of solid carbon combining with oxygen to form carbonic acid, liberates about 14,500 heat units. The same weight of carbon converted into carbonic oxide, liberates about 4,500 heat units.

When a man familiar with furnaces learns that smoke is caused through deficiency of oxygen taken from the air, he nearly always devises a means for providing a remedy. He watches the smoke rising from the surface of the flame, and concludes that all he has to do is to admit more air to strike the smoke before it enters the flues. If he has not read much engineering literature, he will probably proceed to apply for a patent for a plan he has worked out of admitting air to the fuel gases at the bridge of a furnace or below the brick arch of a locomotive. If he has read C. Wye Williams' work on combustion, first published fifty years ago, he will find that Williams' argand furnace was constructed on this principle. But even Williams did not originate the idea. A furnace arranged to admit air behind the bridge was patented by William Thompson in 1796. Since that time there have been several hundreds of patents granted for various methods of admitting air to the front of the fire, and a month seldom passes that does not witness new patents granted in the United States for the same purpose. The ground on which the patent is founded seems to be as slim as the new and original basis of the multiplying patent car coupler.

A favorite subject for smoke-preventing patents in the first forty years of this century, was providing means for taking the volatile gases out of the fuel, and then pushing the coke forward to arrest the smoke from the fresh fuel, as in Watt's dead-grate arrangement. Revolving grates to keep the fuel moving forward, and a great many other ingenious devices, were produced to carry out this idea.

With all the fertility of invention harvesting for forty years, the smoke-preventing problem was so far from being solved when the railway era began, that all the early locomotives burned coke. The earnings of British railways were magnificent for the first decade or two, and the expense of locomotive fuel was of no consequence. But after a time, those evil geniuses of railways, the general passenger and general freight agents, got their arts of rate-cutting into action, and cutting down of operating expenses became the order of the day. It was seen that the fuel account could be greatly reduced by the use of coal in the locomotive fireboxes. Coal could not be legally used unless means were provided for preventing smoke, and accordingly the inventing of smoke-preventing fireboxes began to occupy the attention of every locomotive engineer in the British Isles. The first attempt consisted in dividing the firebox crosswise into two compartments, the coal being burned behind and coke in front.

Next came the first attempt to burn coal over the entire grate without causing smoke. This was done in 1841 on the Midland Railway, the smoke preventer consisting of tubes put through the walls of the firebox, very much as air is admitted into American locomotives under recent patents. For the next sixteen years a great many fantastic devices were patented as smoke consumers that were never seen away from the control of their parents.

In 1857 the brick arch was first applied by Thomas Yarrow, of the Scottish North-eastern—the most meritorious device that has ever been introduced for the prevention of smoke. He also provided independent means of admitting air above the fire in front. The same year D. Kinnear Clark devised his steam-inducted air currents, which consisted of tubes piercing the walls of the firebox at intervals, each tube being provided with a steam jet, which injected the air upon the fire by induction. Still another important invention was patented that year, viz., the baffle plate above the firebox door. These three inventions embrace every appliance of any value that has ever been used in smoke prevention.

When the introduction of coal for fuel in locomotives became general in America, smoke preventers of various kinds were tried, but nothing has proved so successful

as the brick arch with means for controlling the admission of air above the fire. This combination is almost exclusively used on foreign locomotives as a means of preventing smoke.

The question naturally arises: When there have been so many smoke-preventing devices invented, why are they not in more general use? The real reason for this is that no smoke preventer was ever tried that did not waste fuel. This seems paradoxical in view of the numerous scientific treatises that have been published, going to prove that the perfect combustion represented by a smokeless fire shows the fuel giving forth its maximum heat. If furnaces and fireboxes could be so controlled that exactly the volume of air was admitted necessary to effect perfect combustion, there would be economy in admitting air above the fire; but this cannot be done in practice with furnaces that have to generate a varying amount of steam, and it cannot be done with furnaces of any kind unless the fuel is applied continuously, as with automatic stokers. The volume of air necessary for a fresh fire is too great for a fire that has burned clear, and the excess of air wastes the available heat. This truth has come home to every boiler user who has had much experience with smoke consumers. The result of it is the oft-quoted remark, that a good fireman is the best smoke preventer.

There is another phase of the smoke question little heard of which deserves some attention. The transmission of heat to the furnace sheets by radiation greatly increases the efficiency of that part of the heating surface. A pale, non-luminous fire is deficient in radiating power, because air, nitrogen and carbonic acid, which form the bulk of the flame, are very bad radiators of heat. Solid carbon, on the other hand, is an excellent radiator and absorber, and therefore a mass of flame charged with it will radiate heat powerfully. On this account, smoke in furnaces is not an unmixed evil. It improves the radiating power of the products of combustion, and by so doing, compensates for the loss of heat due to the imperfect combustion by which it is produced. Ten per cent. of soft coal mixed with anthracite would greatly increase the efficiency of the latter fuel.

Spirit of Improvement in Railroad Shops.

Any mechanic who has been in the habit of visiting railroad shops for a few years cannot fail to be impressed with the keen interest now displayed in devising methods for reducing the cost of finished work. In large shops and small ones the talk of foremen and leading men is principally upon labor-saving methods which they have introduced. The reduction of help, which has been so general since the hard times came on, has stimulated the men in charge to increased ingenuity in the invention of devices that would enable them to maintain cars and engines in a running condition. Our pages for the last year have been a good reflex of progress in the railroad machine shop.

The boiler shop has not experienced the same spirit of improvement as the machine shop, but the desire for improvement is abroad there also. The crude appliances that were looked upon as perfectly satisfactory a few years ago are no longer regarded with favor. The modern boiler-maker aspires more to operate a machine that will do the work, rather than to wield the riveting hammer and the calking tool. The foreman is no longer proud of the men he has skillful in flanging. He wants a hydraulic flanger, and he thinks that the work would be greatly improved if a plate planer and a new set of bending rolls were put into the shop. He is using air-driven apparatus for drilling and for tapping staybolts, and hopes soon to be using air-operated calking tools. Every improvement opens the way for increased clearness of vision that perceives other new ways of doing things.

The ingenious improvements in wood-working machinery put upon the market in the last few years testify that the men in charge of car shops have not been content to drag along in the rear of the progress procession.

There is one shop, however, in which the visitor can see little change from the appliances and practices in use twenty years ago. This is the iron foundry. A great many railroad companies do not operate an iron foundry, because they can buy the castings they need cheaper than they can make them. This is rather a startling compliment to the owners of iron foundries, and by no means a credit to the railroad companies, which thereby admit that they cannot compete where circumstances are nearly all in their favor.

Railroadmen are proverbially conservative, and the foundry is exceptionally hard to move out of the beaten path. Private owners have at great travail compelled foundrymen to move a little, but most railroad officials have dreaded stirring up this hornet's nest, and so it has been permitted to drag along, using wasteful cupolas and defying the use of good tools. In the course of a lecture on molding machines, Mr. Harris Tabor made some remarks which strikingly illustrate the difference of sentiment between the machine shop and the foundry. He said:

"The foundry has always been comparatively free from machinery. If we except the blower, the rumbler and an occasional power crane, it may be said that the foundry foreman and all his men have had no experience with machinery. This fact has educated these men into a dread of anything which operates independent of the hand, no matter how simple it may be. The manager, knowing this condition, hesitates to adopt new methods until success has been demonstrated elsewhere. On the other hand, the machinist lives in an atmosphere of turning wheels and creaking belts; his whole training has been in the direction of making machinery do his work. Here we have the reason why the machine-shop manager is eager to adopt anything which will reduce cost, when the foundry manager would hesitate. I will cite two cases to show how naturally the works manager will discriminate in favor of the machine shop. Several of our machines are doing excellent work in a foundry, molding castings which require machining. The cost in machine shop on certain castings not molded on machines was 28 cents per 100, which was thought too high, and a special tool was designed and built, at a cost of $3,000, to reduce the cost of 28 cents to 25 cents.

"The foreman of foundry said if they would give him another molding machine, at a cost of $1,000, he would save 75 cents per 100 on the cost of molding these castings. Here a saving in the foundry might have been made 25 times greater than that accomplished in machine shop, at one-third the preparatory cost. In this case the foundry should have come first. The second instance refers to a machine put in last summer with the view to equipping the foundry. I will give as nearly as possible the manager's words: 'The least saving from the use of the steam machine is in molding small castings which require more time for core setting. On this work the steam machine does for two cents the same amount of work that we pay five cents for on hand machines, a saving of three-fifths. On larger work, which costs more to mold by hand, two cents paid on the steam machine gives us the same quantity of work that costs ten cents by the old method—a saving of five to one.' When the suggestion was made that if he could save one-fourth that amount in the machine shop he would not rest until that department was equipped, he admitted the truth and said he intended to take care of the foundry also. He has since put in the second molding machine and is preparing for more. Such cases might be multiplied, did the need exist; they have been introduced to illustrate the hesitancy of the foundry to consider better methods."

Inferior Cast-Iron Wheels.

Car wheels weighing 600 pounds were offered in Buffalo last month at $4.90 each. The people who buy wheels of this kind appear to us to be guilty of criminal recklessness, for wheels so unreliable as these must be, are a menace to the life and limbs of every person connected with the trains where the cars having this kind of wheel find their way. A car load of this character of wheel was recently sent to the car shops of a western road, and thirty-six of them broke when a pressure of 20 tons was put upon them to press in the axles.

In warning railroad companies against the danger of purchasing inferior car wheels, we are not raising a note of false

alarm. Like causes produce like effects every time, and there is every reason to believe that the inferior, cheap wheels going largely under cars in this year of grace, will not act differently from those of a similar character which, for reasons of false economy, were put into service in large numbers eleven or twelve years ago. The harvest of wrecks and serious accidents that resulted from the breakage of wheels roused a storm of indignation in which all kinds of iron wheels came in for bitter abuse. The introduction of steel-tired wheels was greatly stimulated, and investigations were made by competent authorities to ascertain what was the matter with cast-iron wheels.

It was time to investigate, for within one month 4,300 wheels had to be removed from the cars belonging to one road for dangerous defects. During that period of dangerous cheapness purchasers did not descend so low as they are doing now, for seven dollars was paid for the wheels that gave the greatest trouble. What may we expect when wheels bought for five dollars and less get out in large numbers under the cars of fast freight trains that are much more numerous than they were eleven years ago?

The inferior wheels which we have mentioned, thirty-six of which failed to stand the pressure of the axle, are by no means the most dangerous kind that railroad companies are purchasing. They were evidently made from the patterns intended for good iron, and their greatest weakness was in a point readily detected. Those could not have passed the M. C. B. drop test. The people who are doing the greatest business in wheels that are sold for less than good cast iron, have systematically prepared their wheel to endure the M. C. B. drop test. They mass the iron about the hub and put in the greatest resisting power at the points where fracture is most likely to occur under the drop test.

This serves a double purpose. It enables the wheel to pass the drop test, and it prevents the hub from breaking under the strain of applying the axle. This shows great ingenuity. It is a pity to see it devoted to such an unworthy cause. The change made leaves the tread the weakest part of the wheel. That is where we may look for breakage. The Master Car Builders' Association ought to amend the test for cast-iron wheels so that the weight in the drop test should be required to strike the tread or hub, as the purchaser might elect. Unless something is done soon to check the industry of making wheels out of iron not fit for brake shoes, we will soon see another crusade against cast-iron wheels of all kinds.

We have had several requests lately to recommend first-class car draughtsmen. If any who can fill this bill are open for a position, let them communicate with us.

Car Movement.

A well-known superintendent of motive power writes us: Your reference to the Western movement amending the M. C. B. rules, in matter of car interchange, is timely, as the subject was brought several times before the Western Railway Club, and I inclose the printed schedule of proposed changes, many of which are now in experimental use by a few of Western rules. As I have for a long time been more or less interested in these rules, and latterly had a season of experience in the practical management of the details of interchange at an important center of operations, my interest in the same is fresh and impressions thereof clear. The subject has become, to numerous large lines, very important, and possibly there is no center of interchange where reform is so necessary as at Chicago and vicinity; not because Chicago is worse than others, but because of its vast accumulation of business, and its vicinity embraces a hundred miles north, west and south, reaching into other States, with Chicago as a center.

Recently, for one year, I had charge of a road's interest, at a less important center than Chicago, in the interchange of its cars and the repairs of same, and where the business was found to be in the control of a *joint* car inspector for all lines there centering.

I am prepared to certify to the badness of that system from every point of view I was able to obtain, and I was obliged to put on our own inspectors, in addition, to protect our interests. A joint man is necessary as a referee, in cases of dispute where more than two or three roads are interested; but a joint man, with twenty or thirty men as assistants, acting independently of the interested road officials, is not desirable. In fact, it is worse than any other that I have experienced; hence, when it comes to the point of abolishing the system, I do not hesitate to approve of a return to the old plan of each road inspecting for itself—with a joint referee.

Under the new, or proposed new, rules, this inspection must continue, as a means of safety and protection; but the labor will be very greatly decreased, as will also be the delays heretofore experienced in inspection and repairs — made necessary thereby—in consequence of the present rules limiting liability of owners of cars.

It is not exactly a new idea; many have wished and hoped for it to be brought about in years past, and have talked of it. Whoever have had charge of important lines, and have interested themselves in the *details* of car work—the interchange, repairs and office business, and other incidentals—cannot fail, I think, to welcome the prospective change, and in my opinion the courage of those now acting in the matter of experiment is greatly to be commended. It requires men of nerve, favorably situated, to do this, and Mr. Barr, with those associated with him, is of this order of men.

Low Rates Ruining Railroads.

The American Railway Association, which is composed of the general managers of the leading railroads, met at St. Louis last month. There was an unusually good attendance. The most important business of the meeting was hearing the address of Col. Haines, president of the association. His text was "Charges for Transportation," and he took occasion to place before the most influential association in America facts which ought to bear fruit meet for repentance. There is no doubt that the financial embarrassments which so many of our railroad companies are suffering from are due principally to idiotic rate-cutting, which leads competing companies in the scramble for business to transport freight at rates which are below cost.

Col. Haines, who is one of the ablest railroad managers in the country, says that the two lines of figures—one showing paying rates, the other the actual charge for transportation—are constantly drawing together towards zero, which means no profit. Economies of all sorts are resorted to, to prevent these lines from meeting, but they must inevitably come together unless the charges are put upon a business basis. He reminded those responsible for the management of the railroads in this country that further reduction in freight rates must cease if net earnings are to be maintained. The statistics for 1892 and 1893 showed that it was not possible to extend favors of low rates any longer to the public without still further reduction in the wages of railroad employés. The figures for 1894 manifest such a decrease in the volume of traffic as to indicate that, even at present rates, such a reduction is imminent unless some great discovery shall render it possible to bring about a decrease in other items of expense, such as, for instance, followed upon the production of Bessemer steel.

No revolutionary discovery is in sight, and the only alternatives open are better rates or bankruptcy. All the possible resources have been exhausted to reduce the expense of transportation. Reduced wages, economies of all kinds in locomotive and car operating have been savagely enforced, and the low rates keep pace to hold the business of moving freight a losing game. If these railroad managers, to which Col. Haines' words were addressed, would unite to insist on a living profit on the business they perform, it would bring back prosperity to railroads and good times to the country.

As there appears to be an impression that the hotel accommodation will be limited for those attending the conventions at Alexandria Bay in June next, we are notified by Mr. J. B. Wistar, manager of the Thousand Islands House, that he can provide comfortable accommodation for 1,000 persons. Those requiring rooms should write to Mr. Wistar without delay.

PERSONAL.

Ira Petrie, formerly master mechanic of the Jacksonville Southeastern, died at Jacksonville, Ill., April 4.

Mr. T. G. Manning, for the past seven years gang foreman of the Mexican International at Eagle Pass, Tex., has resigned.

Mr. W. H. Potter has been appointed superintendent of the Toledo division of the Pennsylvania lines west of Pittsburgh.

Mr. N. J. O'Brien has been appointed division superintendent of the Southern Railway, with headquarters at Danville, Va.

Mr. W. E. Widgeon, of Logansport, Ind., has been appointed road foreman of engines of the Michigan division of the Vandalia Line.

Mr. John Downs has been appointed road foreman of engines of the Pennsylvania lines west of Pittsburgh, with headquarters at Columbus, O.

Mr. E. B. Wakeman has been appointed superintendent of the Minneapolis Union. He was formerly superintendent of transportation of the Great Northern.

Mr. T. R. Freeman, the well-known supply man, has accepted the position of general sales agent of the National Coupler Co., with headquarters in Chicago.

Mr. Howard James has been appointed superintendent of the Eastern Railway of Minnesota and of the Duluth Steamship Co., with headquarters at Duluth, Minn.

Mr. J. M. Kimball has been appointed general agent of the Erie & Ashtabula division of the Pennsylvania lines west of Pittsburgh. His office will be at Erie, Pa.

Mr. Daniel Breck has been appointed superintendent of the Owensboro & Nashville division of the Louisville & Nashville, with headquarters at Russellville, Ky.

Mr. D. M. King, for twenty years a locomotive engineer on the Seaboard Air Line, has been appointed traveling engineer for that system, with headquarters at Raleigh, N. C.

Mr. John Henney, Jr., superintendent of motive power of the New York, New Haven & Hartford, has had his jurisdiction extended over the whole car department of the system.

Mr. William R. Robinson, formerly of St. Paul, Minn., has accepted a position with the motive power and machinery department of the Seaboard Air Line, at Raleigh, N. C.

Mr. John Dempsey has been appointed master mechanic of the Central of Georgia, with headquarters at Macon, Ga. He was formerly general foreman of the machine shops at Macon.

Mr. E. T. Horn, late general manager of the Macon & Northern, has been appointed superintendent of the Lake Superior & Transfer Railway, with headquarters at West Superior, Wis.

Mr. E. M. Humstone, master mechanic of the Philadelphia, Reading & New England at Hartford, Conn., has been appointed assistant superintendent of that road, with headquarters at Canaan, Conn.

Mr. W. H. Green, for several years general manager of the Eastern system of the Southern Railway, has been appointed general superintendent of the whole system, with headquarters at Washington, D. C.

Mr. G. W. Eaves, of Richmond, Va., has been made general foreman of the Seaboard Air Line shops at Raleigh, N. C. The office of master mechanic, formerly held by Mr. B. S. Shaw, has been abolished.

Mr. J. M. Hale has been appointed superintendent of machinery of the Hoosac Tunnel & Wilmington, with headquarters at Reedsborough, Vt. Mr. Hale was formerly in mechanical department of the C., St. P., M. & O.

Mr. Frank H. McGee has resigned as master mechanic of the Central of Georgia, at Macon, Ga. The employés of the mechanical department on April 1st presented him with a $300 silver service as a token of esteem.

Mr. S. A. Chapiot, secretary of the Southwestern Railway Club, has been appointed master car builder of the Georgia Central, with headquarters at Macon, Ga. Mr. Chapiot was master car builder of this road before.

Mr. H. W. Byers has been appointed superintendent of the Erie & Ashtabula division of the Pennsylvania lines west of Pittsburgh, *vice* Mr. J. M. Kimball, transferred. His office will be at Lawrence Junction, Pa.

Mr. J. S. B. Thompson has been appointed assistant general superintendent of the Southern Railway, with headquarters at Atlanta, Ga. He was formerly superintendent of the Danville division of the same road.

Mr. T. A. Switz, formerly assistant general manager of the Great Northern, has been appointed purchasing agent of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., to succeed Mr. W. T. Watkins, resigned.

Mr. C. W. Corson has been appointed assistant to Mr. F. D. Casanave, general superintendent of motive power of the Pennsylvania R.R., at Altoona, Pa. He was formerly road foreman of engines of the Pennsylvania lines, with headquarters at Columbus, O.

Mr. Jacob W. Mack, secretary and treasurer of the Nathan Mfg. Co., has been appointed School Commissioner by Mayor Strong, of New York. The press, representing all shades of political opinion, acknowledge that the appointment of Mr. Mack is one of the best which Mayor Strong has made.

Mr. L. H. Miller, who has been for some time general superintendent of the Indiana, Illinois & Iowa, has resigned the position, and has taken charge as master mechanic of the road. This change was made at his own request, impaired health unfitting him for the responsibilities of general superintendent.

Señor Canovas, Prime Minister of Spain, began his working life as a railroad man. He is noted for the picturesque quality of the invectives he uses, without much care of where they apply. His railroad training is reputed to have greatly added to this accomplishment. The familiar sobriquet he goes by is "the monster."

Mr. William A. Nettleton has been promoted to the position of superintendent of motive power of the Kansas City, Ft. Scott & Memphis R.R., in place of Mr. John S. McCrum, assigned to other duties. Mr. Nettleton has been acting superintendent of motive power. He is a technical school graduate and mechanic, and is particularly well up in all matters relating to railway machinery.

Mr. W. G. Nevin, assistant to First Vice-President Robinson, of the Atchison, Topeka & Santa Fé, has been appointed general purchasing agent of that road, to succeed Mr. W. G. Tuller, resigned. Headquarters, Chicago. Mr. Nevin has been assistant to the first vice-president since last November, and was formerly chief clerk to the general manager of the Gulf, Colorado & Santa Fé, at Galveston, Tex.

Mr. C. B. Royal has been appointed master mechanic of the Seaboard Air Line, at Portsmouth, Va. Mr. Royal has been for several years an engineer on the South Side Elevated Railroad of Chicago. He learned the machinist trade in the shops of the Chicago & Northwestern at Chicago, and has had considerable surface railroad experience. He is a son of Mr. George Royal, of the Nathan Mfg. Co.

In the death of Mr. W. P. Pike, superintendent of the Louisville & Nashville R.R., another mechanic who rose to prominence in the railway world has passed away. Mr. Pike served his apprenticeship as a machinist in the Edgefield & Kentucky R.R. shops, and afterwards went firing, and rose through the positions of engineer, shop foreman and master mechanic to be superintendent. He was a very popular and efficient officer.

Mr. F. A. Seabert has been appointed assistant superintendent of the Tucson & Yuma division of the Southern Pacific, with headquarters at Tucson, Ariz. Mr. Seabert came up through the train department, and rose on the D., L. & W. from conductor to be superintendent of the Western division. He went West on leave of absence for his health, and was so much improved by the dry climate of Arizona that he decided to make that his permanent home.

Mr. J. B. Brady has gone to Europe to

be absent five weeks. He went on the steamship *Umbria*, which was a day longer than usual in making the passage. Some of Mr. Brady's critics say that the cause of the delay was the treating which he gave the firemen that prevented them from being able to keep up steam. We believe this to be a slander, however, and think that the real cause of the delay was the unusually severe weather which the vessel encountered.

Mr. Richard Dudgeon, whose name is familiar to every person who uses hydraulic tools, died at New York last month. He was the inventor of the hydraulic jack and of numerous other improvements in hydraulic machinery. Mr. Dudgeon was a Scotchman by birth, but spent all his working life in this country. After learning the machinist trade, he started in business for himself in a small way, and gradually built it up until he had one of the best shops in New York City.

The numerous friends of Mr. J. S. McCrum, for twenty-five years head of the mechanical department of the Kansas City, Ft. Scott & Memphis R.R., will be sorry to hear that his health continues to be so unsatisfactory that he has been compelled to resign this position. President Nettleton has kept Mr. McCrum nominally at the head of his department for several years, when he was unable to perform the duties, and has now assigned Mr. McCrum to easy work, which will not tax his strength.

Mr. M. M. Reid has been appointed master mechanic of the Atlantic & Danville R.R., with headquarters at Portsmouth, Va. Mr. Reid has been for the last two or three years general foreman of the Norfolk & Southern R.R. shops at Berkley, Va. Before that he was on the Baltimore & Ohio, and has had extended experience as a shop manager. The company he has gone with is building large shops at Lawrenceville, Va., and Mr. Reid is devoting himself to getting the shops properly equipped.

Mr. Jules Viennot, who is proprietor of an advertising agency in Philadelphia, which bears his name, is a knight of the French Legion of Honor. Mr. Viennot is agent for forty-five of the largest manufacturing concerns in and about Philadelphia, and is noted for the intelligence and rigid impartiality which he displays in selecting advertising mediums. He is an arch-enemy of all advertising humbugs, and stands as a most polite buffer between his employers and the men who try to make money by getting up folders, programmes and other nets to catch unwary advertisers. The greater part of the manufacturers in Philadelphia who sell to railroad companies employ Mr. Viennot to look after their advertising.

Capt. John G. Mann has been appointed general manager of the Mobile & Ohio, with headquarters at Mobile, Ala. Capt. Mann was formerly assistant chief engineer of the Illinois Central, and had a highly varied experience in the location and construction of railroads. He began work as an assistant engineer on the Cleveland, Columbus & Cincinnati, and was a resident engineer of the M. & O. for three years before the war. He was for a short time a passenger conductor, and left that to enter the Confederate army, in which he fought—first as lieutenant and then as captain of an engineers' corps. Since the war he has been superintendent of different divisions of the Illinois Central, and rose to be chief engineer of the Yazoo & Mississippi Valley road.

Mr. C. H. Hudson, for the last seven years general manager of the East Tennessee, Virginia & Georgia, has been appointed chief engineer of the entire Southern Railway system, with headquarters at Washington. Mr. Hudson is a graduate of the Engineering School of Harvard University, and has had a great deal of engineering experience on railroads. He was for several years superintendent of divisions of the C., B. & Q., and was for a time general manager of the Minneapolis & St. Louis. Mr. Hudson has devoted a great deal of attention to mechanical matters, and a paper which he read on Compound Locomotives at one of the Engineering meetings attracted general attention and did much to enhance the popularity of compound locomotives in this country.

Mr. E. T. Silvius has purchased a half interest in the Thurman Fuel Oil Burner Co., of Indianapolis, Ind., and will have charge of the railroad department. The company has a fire kindler which Mr. Silvius expects will meet with ready patronage. Mr. Silvius was for ten years master mechanic of the Jacksonville, St. Augustine & Indian River Railroad. He learned the machinist trade at Renovo, Pa., and worked there with W. L. Foster, W. H. Thomas, H. K. Stout and others who afterwards became master mechanics. By the way, Renovo shops appear to have turned out more apprentices who rose to be master mechanics than any other shops in the country. From Renovo, Mr. Silvius went West, and ran a locomotive for two years. He also had some experience as a shop foreman before going to Florida in 1883.

Mr. L. B. Paxson, superintendent of motive power and rolling equipment of the Philadelphia & Reading, knows more interesting things about the development of the American locomotive than any man of our acquaintance. He is in possession of facts that would be of much historical value. Unfortunately, Mr. Paxson has a horror of what he calls newspaper notoriety, and the most enterprising editors have failed to induce him to undergo an interview in the presence of a stenographer. He has been nearly fifty years on the Philadelphia & Reading. When he went to work on the Reading, it was only 58 miles long. In its early history, this railroad was the most enterprising in the country in the developing of improved rolling stock, and Mr. Paxson has been an eye-witness of all that was done. Much important work was carried on under his supervision.

Mr. George W. McGuire, one of the best known and most popular men in the railroad supply business, died at Savannah, Ga., last month, where he was living for his health. Mr. McGuire was born in Ohio, and had some railroad experience in an engineers' corps. He learned the trade of iron molder in Lima, O., and worked at the trade in various places. Fifteen years ago he was made superintendent of the Cleveland Malleable Iron Co., and he retained his connection with that firm to the end. He was so successful as a sales agent that during the last ten years he devoted himself almost entirely to that department of the business. A cheerful, pleasing manner made him a welcome visitor to railroad men, and he seldom visited offices on business without making personal friends. About three years ago his health became impaired through overwork, and the illness developed into aneurism of the heart. The doctors told him that recovery was hopeless, and they intimated that he might die at any moment. With this malady, like the sword of Damocles hanging over him, George went about his daily duties as cheerfully as if he were blessed with the best of health. He made such a long, brave fight with the dread disease that many of his friends were hoping that he was coming off the victor, but it was not to be. He and his wife have been for years among the most active workers at the mechanical conventions, and many will be sad at their absence this year.

The Air-Brake Men's Association held its second annual convention, at St. Louis, Mo., April 9th, 10th, 11th and 12th. It is never our purpose to publish in full, reports of any association; but if it were, we should certainly select the papers presented at this meeting—they were admirable. The older associations could well learn something from this youngster in expeditious ways of doing business. There were just about 100 members in attendance. The meeting hours were from 9 to 12 and from 2 to 5. At no moment during the session, on any day, was there more than 10 per cent. of the membership absent from the room. We expect, and intend to publish extracts from the reports presented—they were all live questions of the hour. President Hutchins was absent the first three days, owing to the sudden death of his mother; this was very much regretted, as "Sam" is usually the life of the convention; but the meetings were ably presided over by Mr. C. P. Cass, of the St. L. & S. F. road. General officers should encourage this association, for its whole object is education on the all-important matter of power brakes.

The Effect of Engine-Truck Brakes on Train Stops.

At the recent convention of Air-Brake Men held in St. Louis there was presented, among other able papers, one of especial interest on driver and engine truck brakes.

This committee had compiled a lot of information on the influence of engine-truck brakes from actual experiments made on the Old Colony road.

The report gives a number of tables, showing the effect on stops with different weights of trains at different speeds; but all of the information there contained is put into graphic condensation in the plate here shown.

One can see at a glance just how far a train of three, four, five or six cars would run before being stopped, at any speed between 30 and 60 miles per hour, by the brakes either in service application or emergency, and how this service is improved by the use of an engine-truck brake.

The brake used was the same as shown in this paper last month. There are now about 100 of these brakes in service; but from the showing here made, it would appear a good long step toward increased efficiency if more of them were put into service.

This kind of data is the useful kind, the kind that it is safe to figure from, as it was obtained by actual stop tests on a road instead of being figured out on a drawing board.

He Was Used To It.

"Jest after the war," remarked the old-timer, as he picked up our half-burned cigar and relit it, "fall of '65 and winter of '66, you know, we had the first big Brotherhood strike—it were on the Michigan Central. They fit us, and hired everything that came along to run the engines. One feller they got was a n'old-timer who'd jest come up from the front—been running fer Uncle Sam amongst the bushwhackers.

"He were a gamey old buffer, an' was us't to being stoned and shot at. Why, he jest smiled at the boys when they throwed bricks at him.

"One night he went out on the express, and some desp'rit cusses had took up a rail and put out about twenty torpeders each side of it.

"When that old fish-kittle hit them torpeders, ker bang-et-e-bang! Old sodjer jest slid down behind the seat box and yelled:

"'Blaze er-way, ye sons o' guns, yer kant skeer me—I've been there afore!'

"She only turned over twic't, and when the crew got up to him, the old man was layin' flat as a pancake in the ditch, mutterin' to hisself:

"'Mosby, by thunder; no idee he waz around here—but you jest wait till Pap Thomas gits after his pelt!'"

Illinois Central passenger engine 1447 received general repairs at Waterloo shops in month of July, 1890, and remained in service until January, 1895, without being taken off her wheels, or having driving boxes refitted. During the four years and five months of service, this engine ran 164,133 miles, and averaged 42 miles per ton of coal, 112 miles per pint of valve oil, and 65 miles per pint of engine oil. As this engine did not have a lubricator, and was used as a push engine for two years and a half in addition to her regular run, the performance is worthy of notice.

BOILER-MAKING.

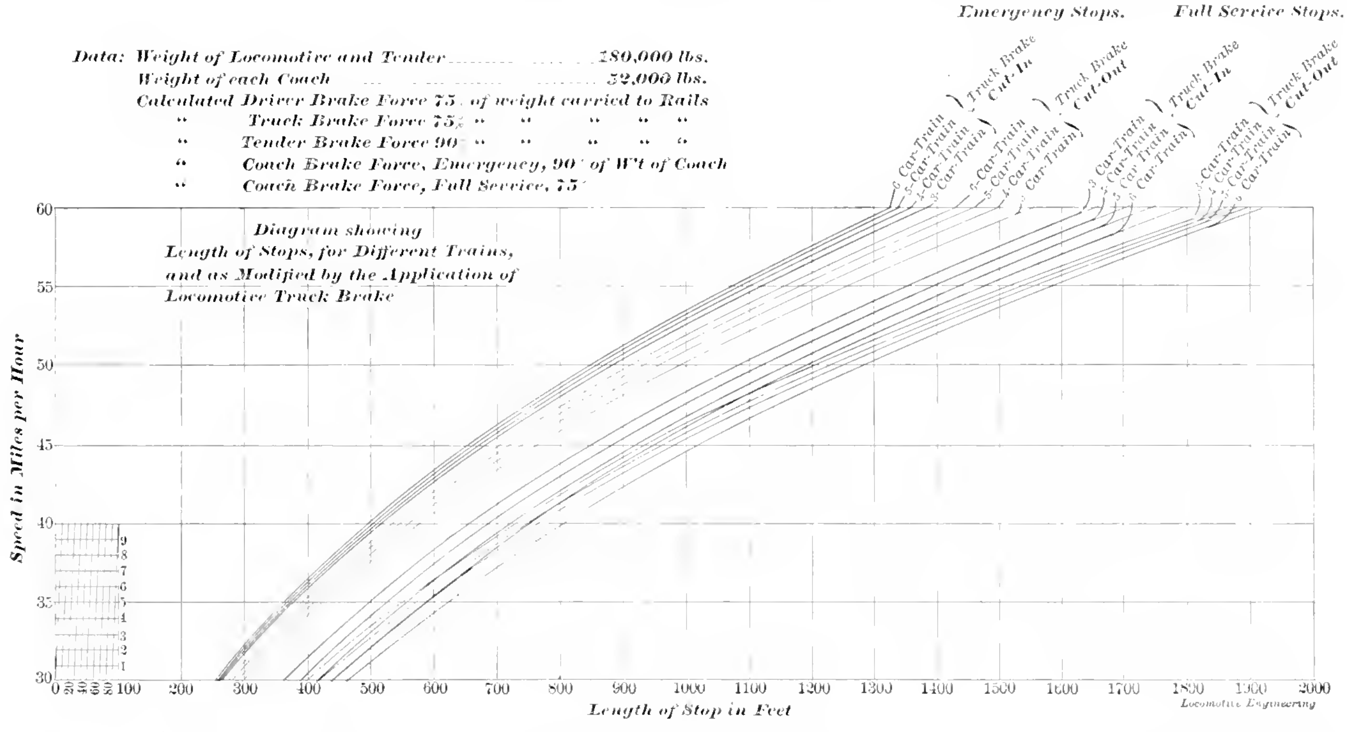
By C. E. Fourness.*

In this series on boiler-making, the intention is to treat upon the boiler very completely, regarding the strengths of different parts as well as the laying out. As my greatest difficulty has always been to know where this information could be procured, I will give some of what I have collected from various sources. I have subscribed for papers, and paid from $1 to $15 for different books on boilers, etc., that were to give all the information there was to be had about a boiler. But they would not always conform to what was found by experience to be practical, and as they are generally written by mechanical engineers, a man must go slow in adopting any rule, and be sure he is right, then go ahead. Again, a great many practical men are very conservative, and do not like to move out of the old rut. A great many have only a limited education, and they use their judgment in most cases to determine sizes and proportions. But I consider any foreman or person who determines sizes of braces, stays, etc., and the number required to support certain amounts of surfaces, should be able to figure the strain upon these parts. To be sure, there is ample support, and still not more than necessary. It is very satisfactory, indeed, to be able to demonstrate, by a reliable authority, that ample strength has been allowed, and not be obliged to say it looks, or in my judgment it is strong enough. I will now define a few of the terms used in boiler-making.

DEFINITIONS.

1. *Tensile strength*—Is the strain at which the fibers or particles of a body are forced to separate.

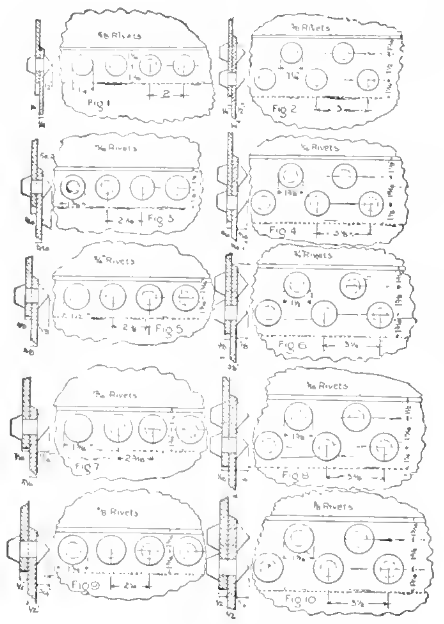
*Foreman Boiler-maker, C., M. & St. P. Ry., Dubuque, Iowa.



2. *Cohesion*—Is the strength with which component parts of a rigid body adhere to each other.

3. *Elasticity*—The amount a body will stretch under strain, and still assume its original form upon being relieved.

4. *Ductile*—Soft, flexible, pliable; that can be stretched or worked to a great extent, without injury.



5. *Elongated*—Stretched, lengthened.

6. *Laminated*—In layers.

7. *Blistered*—When laminated material is exposed to heat, the outside layer will swell out like a bladder.

8. *Homogeneous*—Solid, compact—each particle forming a body being the same.

9. *Fibers*—Long, slender threads lengthwise through iron and other material.

10. *Crystallized*—Hard, brittle.

11. *Factor of safety*—Is the number of times the bursting pressure is greater than the working pressure.

BOILER SEAMS.

No doubt a great many persons have noticed boiler shells with the straight (longitudinal) seams double riveted, strapped, welted, or a combination of two of them, when the girth seam would only be single riveted. I will demonstrate that if the shell was full strength all around (had no straight seams) a single-riveted girth seam would still be the strongest. For example, take a steel shell $\frac{3}{8}$ inch thick, 48 inches in diameter and 10 feet long; tensile strength, 60,000 lbs. The total pressure required to burst this shell would be the area exposed times the pressure. The thickness multiplied by the length, then by 2 (as there are two sides), then by the tensile strength, equals the bursting pressure: $\frac{3}{8}'' \times 120 \times 2 \times 60{,}000 = 5{,}400{,}000$, the total bursting pressure; and the pressure *per square inch* required to burst the boiler is found by dividing 5,400,000 by the diameter times the length (the projected area): $5{,}400{,}000 \div (48 \cdot 120) = 937$ lbs.

The total pressure required to force the boiler apart lengthwise would be the area exposed (one end) times the pressure per square inch. The area of one end $48 \times 48 \times .7854 = 1{,}809.56$. And to resist this pressure there is the ring of metal all around the shell, which equals the circumference times the thickness times the tensile strength; $48 \times 3.1416 \times \frac{3}{8} \times 60{,}000 = 3{,}391{,}875$, and $3{,}391{,}875 \div 1{,}809.56 = 1{,}874$, the pressure per square inch required to tear the end or head out of the shell—where one-half of this pressure, or 937 pounds per square inch, will burst the shell. If the heads were riveted in, and the rivets pitched as given in the table following, single riveted for $\frac{3}{8}$-inch sheet and $\frac{3}{4}$-inch rivets, a strength of .62% of the solid iron would be secured, and $1{,}874 \times .62 = 1{,}162$ lbs. per square inch would be the pressure required to pull the shell apart through this girth seam, where 937 lbs. per square inch would burst the solid shell.

To determine the working pressure, divide the bursting pressure of the weakest part by the factor of safety required. The United States Government use a factor of safety of 6 for single-riveted, with an additional .20% added for double-riveted straight seams: $937 \div 6 = 156 + .20 = 187$ lbs. per square inch for a new boiler.

Some companies and corporations take the per cent. of strength of the straight seams as a basis for determining the working pressure, and I think that is proper, as the straight seam is the weakest part of the shell. For instance, in the shell under consideration, the double seam in the table gives a strength of .75% of the solid iron: $937 \times .75 = 702$ lbs. per square inch required to burst the shell at the straight seams, and 702 divided by a factor of safety of 5 equals $702 \div 5 = 140$ lbs. per square inch working pressure. This reduces the pressure allowed by the Government 47 lbs., but it is safer, and there is an incentive to improve the straight seam, and thereby increase the working pressure. The rule or formula used by the Government inspectors for the boilers of steam vessels is one-sixth of the tensile strength times the thickness in decimal parts of an inch divided by the radius of the boiler in inches. This equals the working pressure for single-riveted seams, and 20% can be added to the working pressure by double-riveting the straight seams; also all rivet holes in the boiler must be drilled. There is a great difference of opinion in regard to this last feature. A hole punched injures the sheet, but a drilled hole being so sharp at the edge, it shears off the rivet much sooner than a punched hole, and it is claimed that one about balances the other.

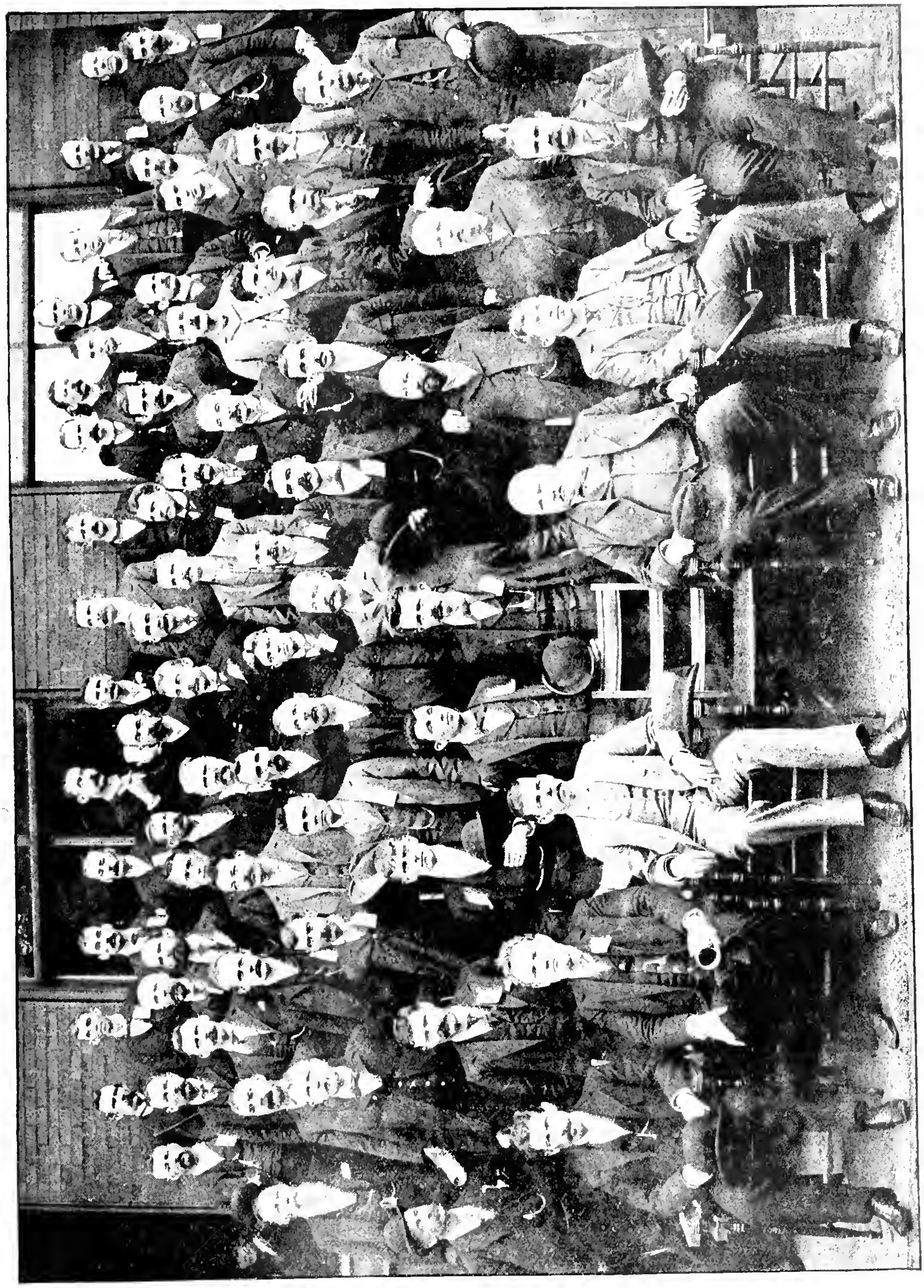
The table given with pitch of rivets, etc., I consider is very complete, as it covers all points about seams in ordinary work. Something of this kind hung up in a shop (with directions to follow it) would insure uniformity. The illustrations show all the proportions as given in the table. These are very wide pitches, the percentage of strength of the sheet and the rivets being very nearly equal. But I have used these pitches in my work with excellent results.

TABLE.

PITCH OF RIVETS, PER.CENT OF JOINT, SIZE OF RIVET HEADS, LENGTH OF RIVETS REQUIRED HAND RIVETING, & DISTANCE FROM THE CENTER OF RIVET HOLES TO EDGE OF THE LAP.

THICKNESS OF PLATE	DIAM. OF RIVETS	PITCH SINGLE RIVETING	PITCH DOUBLE RIVETING	DISTANCE APART OF ROWS IN DOUBLE SEAMS	PER.CENT OF JOINT SINGLE RIVETING	PER.CENT OF JOINT DOUBLE RIVETING	DIAM. OF RIVET HEAD	HEIGHT OF RIVET HEAD	LENGTH OF RIVET HAND RIVETING	DISTANCE FROM THE CENTER OF RIVET HOLE TO THE EDGE OF THE LAP
$\frac{1}{4}''$	$\frac{5}{8}''$	$2''$	$3''$	$1\frac{1}{2}''$	.66	.77	$1\frac{1}{4}''$	$\frac{1}{2}''$	$1\frac{3}{8}''$	$1\frac{1}{16}''$
$\frac{5}{16}''$	$\frac{11}{16}''$	$2\frac{1}{16}''$	$3\frac{1}{8}''$	$1\frac{9}{16}''$	.64	.76	$1\frac{3}{8}''$	$\frac{9}{16}''$	$1\frac{1}{2}''$	$1\frac{1}{8}''$
$\frac{3}{8}''$	$\frac{3}{4}''$	$2\frac{1}{8}''$	$3\frac{1}{4}''$	$1\frac{5}{8}''$	.62	.75	$1\frac{1}{2}''$	$\frac{5}{8}''$	$1\frac{3}{4}''$	$1\frac{3}{16}''$
$\frac{7}{16}''$	$\frac{13}{16}''$	$2\frac{3}{16}''$	$3\frac{3}{8}''$	$1\frac{11}{16}''$	.60	.74	$1\frac{5}{8}''$	$\frac{11}{16}''$	$2''$	$1\frac{1}{4}''$
$\frac{1}{2}''$	$\frac{7}{8}''$	$2\frac{1}{4}''$	$3\frac{1}{2}''$	$1\frac{3}{4}''$	.58	.73	$1\frac{3}{4}''$	$\frac{3}{4}''$	$2\frac{1}{4}''$	$1\frac{5}{16}''$

Mr. H. A. Luttgens has recently patented a simple device for regulating the opening and closing of his stack base damper from the position of the reach rod. This makes the opening vary with the position of the reverse lever and makes the operation automatic. It can be set to any opening at any point, but once set, takes care of itself.



Group of Members, Air-Brake Men's Association, St. Louis, April 9, 1895.

The Air-Brake Men's Association put themselves on record as approving metallic packing for air pumps, and against any kind of fibrous packing. One member spoke highly of the Duval packing, which is a metal packing composed of fine wires braided into strands of the proper size. Not one member defended the ordinary wick, rubber wound or asbestos packings, all of them agreeing that such packings required constant attention and soon burned hard, scoring the rod and being difficult to remove. Some use a solid ring cone packing of home make, but most of them use a regular packing of the United States, Jerome or Columbian make.

Fifteen sons of members of the Railway Master Mechanics' Association will compete for the Stevens' scholarship this year.

Heavy Consolidation for Pittsburgh Junction Railroad.

We show on this page a cut of a very large locomotive recently built by the Pittsburgh Locomotive Works for the P. J. road.

From a glance at the picture, no one would suspect that the cylinders were 22 x 28 inches and the boiler 6 feet in diameter. This is because there is nothing shown in the picture of known size to compare parts to.

The engine is a very symmetrical one in outline, with no "notions" about her; she is as near as possible a standard "Pittsburgh." Her principal dimensions are as follows:

Fuel, coke.

Gage of track, 4 ft. $8\frac{1}{2}$ in.

Total weight of engine, in working order, 160,000 pounds.

Total weight on drivers, in working order, 148,000 pounds.

Working pressure, 160 pounds.

Grates (cast iron, rocking), $35\frac{1}{2}$ sq. ft.

Heating surface in tubes, 2149.2 sq. ft.

Heating surface in firebox, 169.5 sq. ft.

Total heating surface, 2318.7 sq. ft.

Diameter of driving wheels, outside of tires, 50 in.

Diameter and length of journal, $8\frac{1}{2}$x9 in.

Diameter of engine-truck wheels, 30 in.

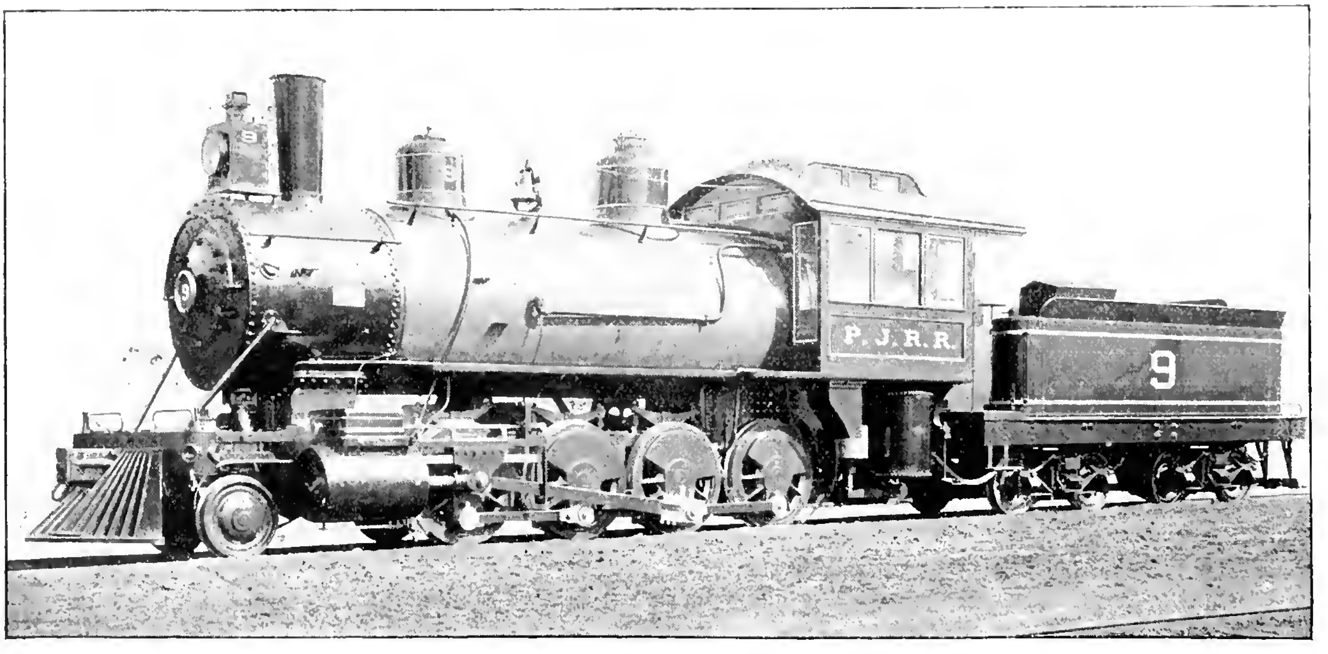
Diameter and length of journal, 5x10 in.

Weight of tender with fuel and water, 79,000 pounds.

Water capacity, 3,500 U. S. gallons.

Coal capacity, 360 cubic ft.

The Westinghouse American outside equalized brake is used.



22 x 28 Consolidation for Pittsburgh Junction Railroad.

Driving-wheel base of engine, 14 ft.

Total wheel base of engine, 22 ft. 1 in.

Total wheel base of engine and tender, 52 ft. $5\frac{1}{2}$ in.

Height from rail to top of stack, 15 ft. 4 in.

Cylinders, diameter and stroke, 22 x 28 in.

Piston rods, steel, 4 in. diameter.

Type of boiler, straight.

Diameter of boiler at smallest ring, 72 in.

Diameter of boiler at back head, $74\frac{3}{8}$ in.

Crown sheet supported by radial stays, $1\frac{1}{8}$ in. diameter.

Staybolts, 1 in. diameter, spaced 4 in. from center to center.

Number of tubes, 272.

Diameter of tubes, $2\frac{1}{4}$ in.

Length of tubes over tube sheet, 13 ft. 6 in.

Length of firebox, inside 121 in.

Width of firebox, inside, $42\frac{1}{4}$ in.

A Qualification.

Foxey Hall is a bragger, anyway, and some of the boys say he handles the truth right recklessly when telling of feats performed by his engine—with his valuable assistance. Besides that, "Foxey" is contrary and always on the other side of the argument.

Not long since the road got some new moguls, which were the pride of the earth except in the important matter of steam—they came of a cool-blooded family.

"Foxey" stopped just below town the other day and filled his boiler up, both with steam and water, then came into town with the door open and both pops up.

Several of the men running ice-cream freezers—mates to "Foxey's" engine—gathered around her, and the master mechanic came to find out how Hall had arranged her front end.

"Hall," said he, "how is she?"

"Away up, sir," said Hall, "away up in G. Steam? Why, it 'ud just do your heart good to hear her howl [so it would]; she's a steamer from Steamville, and the harder you hit her the better she steams—ain't that so, Firesey?"

"Yep," said the fireman, who was honest, "pervidin' ye don't hit her too *darn* hard."

The Most Important Railroad Man.

Mr. C. W. Bradley, general superintendent of the West Shore, is one of the soft-talking gentlemen who make points by means of quiet jokes. The jokes are generally quite pointed.

"Who do you think is the most important official connected with railroad operating?" was asked Mr. Bradley, lately. He made a brief mental review, and then answered, "The car inspector."

"That man has the whole of us by the heels," he continued. "We smaller people put in hard work securing business for the company. Some of us labor to get freight rushed through to its destination, and we try to keep things moving. We sit up nights figuring on how we can save an hour for a car between New York and Buffalo. All at once the car inspector holds up his paralyzing chalk, and everything stops.

"The car inspector has had his turn. I think it is time that superintendents and managers and presidents should have something to say about how the business shall be handled."

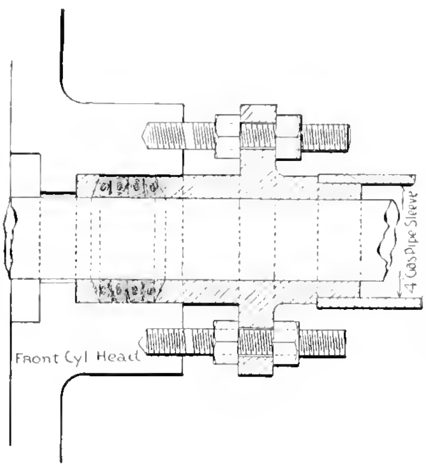
Out on the St. Louis & San Francisco, they have what is known as "high-wheel seniority." When a man is old enough, he kicks for a large-wheeled engine, and gets rid of a low-wheeled one, of which there are not many, and known in local parlance as "creepers."

Extended Piston Rods.

Editors:

Your article on the above in your March issue, in some respects, I do not agree with.

If it is necessary to put an extended rod on a heavy piston, through the front cylinder head, that is all right, and very necessary. I recently did so on the low-pressure pistons of a Baldwin compound. My reasons for doing so were, that the pistons being a solid head (with block tin lining



all around), the bottom wore down and would carry the crosshead down on front end out of line of center line of the guides, so that it would wear the block tin lining of the crosshead on the bottom at front end and on the top at the back end.

To remedy the matter temporarily, we turned the pistons around. After that we took pistons out and renewed block tin lining. We finally had to do something. The engine was taken into shop to turn tires, etc., and while in we put on extended rods and new pistons with bull rings and followers. We used old front cylinder heads, but *did not use Jerome glands*. These extended piston rods made a decided improvement in the working of the pistons and crossheads.

As far as this we agree with your article, but when you say a stuffing box with "Jerome" packing was applied to the pistons in question in your article, we do not believe they would give satisfaction.

Some time ago we received a two-cylinder compound having an extended piston rod on low-pressure piston running through front cylinder heads, and it had Jerome gland. I asked the engineer who came with the engine, what that was for. He answered: "Why, to carry the weight of the piston, of course." Well, does it do so? Is there not 1/8 in. all around that Jerome packing, so that it can follow the piston rod wherever it wanted to go? And such was the case. The piston was resting on the bottom of the cylinder and *not in the gland*, as supposed. After a while we began to have trouble. The piston head and follower were cast steel (to lighten it), and it began cutting the bottom of the cylinder. We took away the Jerome packing and glands, and put in one like sketch (giving a long wearing surface), and have had no trouble since. The glands we put in did what was intended, as it kept the piston in the neighborhood of the center line of the cylinder, whereas the Jerome gland did not. DAVID BROWN, M. M.,

Scranton, Pa. D., L. & W.

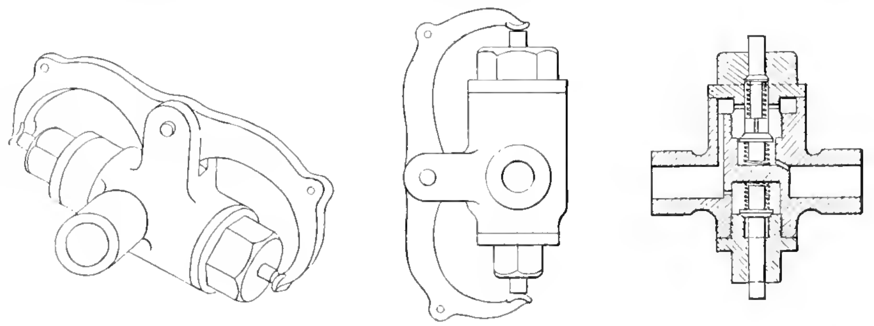
Air Hoist.

Editors:

Seeing in the February LOCOMOTIVE ENGINEERING a cut of a valve for an air hoist, I thought the one planned and constructed by myself, and now in successful operation at the C. & O. shops here, might be of interest to some of your readers. Inclosed please find sectional cut and two perspective views of the valve.

The valve is very small, only weighs two and a half pounds complete with lever, and of that size can be used on hoists that will lift as high as ten tons.

Being a safety appliance, it holds the load in any position the operator desires, and cannot be handled dangerously, because the air passages are made so the air



cannot enter or exhaust fast enough to cause trouble. The valve is small, compact and neat. I think the views and cut will explain themselves. C. O. MIKLE.

Huntington, W. Va.

Full Throttle and Close Cut-off.

Editors:

Flat spots on tires have been attributed to using steam with a high grade of expansion in LOCOMOTIVE ENGINEERING, first by D. O. Smith, M. M. of the M. & O. R. R., in December, and Mr. W. E. Amann in your March issue. After looking the subject over, the writer sees no reason why excessive cushion, or initial pressure, or both, should have a greater tendency to slip the driver than moderate pressures. The flat spot on the right-hand driver, 90° ahead of the crank, as regards the right-hand engine, will be considered first.

In going over the forward center, the axle box is forced back against the wedge (or shoe) by any excess of steam pressure above that is required to bring the reciprocating parts of the engine to rest, plus the centrifugal force of the counterweight in the driver, less the centrifugal force of the parallel rod, crank pin and its hub. Now it appears that whatever play there is in the axle bearing, or axle box, that the driver will be slipped back on the rail a like amount. This will occur whenever the forces just referred to are sufficient to slip the wheel on the rail, and the result is "pound," which is hardest (other things being equal) when the pressure on the piston is the greatest, indicating that the lost motion is taken up in less time when a higher pressure is used. If the lost motion is considerable, and the engine running at high speed, with the links, as "Swifty" has so pathetically expressed it, "a-draggin' on the ties," and the throttle closed until there is barely steam enough in the cylinders to force the axle box from its front to back support while going over the forward center, then the slip will wear a small arc of the tire to a smaller diameter than the rest of the wheel. The length of the arc will depend on the time the wheel is slipping. If the axle-box movement requires but a very short part of the time of a revolution, as it would when the engine was running slow, with full throttle and close cut-off, a flat spot on the tire would be the result, but it ought not to be deeper than the wear of

the short arc, although it might be much more objectionable.

In regard to the vertical lift of the left-hand driver, due to the centrifugal force of its counterweight, and the tendency of the left-hand engine to slip the drivers while the right-hand engine is on the center; it will be seen, that for a given load for the engine to pull, or what is the same thing, for a given average steam pressure on the pistons, that the higher the initial pressure, and the earlier the cut-off, the less pressure there will be on the piston of the left-hand engine while the one on the right side will be going over the center. As illustrating: Take an engine of 24-inch stroke, cutting off at 4 inches, and to have an average pressure of 60 pounds, which will require an initial pressure of 146 pounds and will have a mid-pressure of but 40 pounds. On the other hand, if we cut off at half stroke, an initial pressure of 75 pounds will be required for an average pressure of 60 pounds, and a mid-pressure of 75 pounds, being, of course, the same as the initial pressure, which gives the left-hand engine nearly twice the force to turn the drivers, with the right-hand engine on the center, than it had with the 4-inch cut-off and 146 pounds initial pressure. It will be seen that these are theoretical figures, but the proportion will be somewhere near the same in practice.

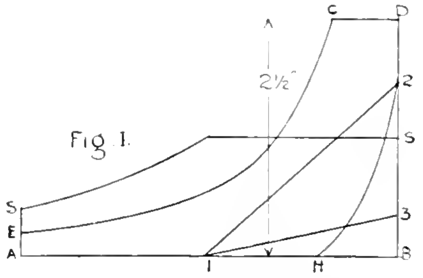
What I think to be a remedy for some of the evils of running with full throttle and close cut-off, is to reduce the lead and compression, and thereby relieve the bearings of a center pressure that is not only useless, but also injurious.

Another method of relieving the bearings of center pressure is to increase weight of the crosshead or piston head, or both, and by that means store the force at the center, and pay it back later in the stroke. The objection to this method is that it increases wear and friction, and, as the following calculation will show, it takes lots of extra weight when running at moderate speeds to amount to any perceptible advantage.

The inertia forces of the reciprocating parts of an engine are susceptible of being represented by a diagram, the same as the pressure on the piston is by an indicator card. The only difference is that the inertia diagram is produced by calculation. An accurate diagram of these forces is difficult to draw, but a fairly close approximation is very easily made, as follows: Assume that the weight of the reciprocating parts (piston head, crosshead, piston and connecting rods) is located at the center of the crank pin. Then the centrifugal force of such weight is equal to the forces of reciprocating parts of like weight and number of revolutions at the end of their stroke. For any weight at crank pin has no vertical centrifugal force while the engine is on the dead center, it being all in a horizontal direction.

With the engine a quarter turn from the position just stated, the centrifugal force is all in a vertical direction; hence, with the piston at such part of the stroke as corresponds with a vertical position of the crank pin, there is no horizontal force affecting the reciprocating parts, that is due to their weight, but from the instant that point is passed, the horizontal force due to their weight increases, till at the end of the stroke it amounts to the centrifugal force of a like weight, as has been stated. The centrifugal force of any revolving body is equal to its weight multiplied by the square of its velocity and divided by the product of the radius multiplied by 32.2 (the acceleration of gravity). What amounts to the same thing, and is much more convenient, is to multiply the weight in pounds by the radius in feet, and this product by the number of revolutions per minute squared, then divide by 2,933.54; the quotient is the centrifugal force in pounds.

Suppose it to be required to represent on an indicator card the force the weight of the reciprocating parts plays in regulating the pressure on the crank pin of an 18 x 24 engine, steam at 150 pounds per square inch, cutting off at 4 inches, and running 325 revolutions per minute—the weight of reciprocating parts to weigh 765 pounds



(about 3 pounds per inch of area of piston). Then the force necessary to balance the reciprocating parts at the end of the stroke, in pounds per square inch of piston area, will be $\frac{765 \times 1 \times 325^2}{254 \times 2{,}933.54} = 108$. The accompanying diagram (Fig. 1) is drawn to a vertical scale of 60 pounds per square inch of piston area, in which the line *1, 2*, represents the force just spoken of, and gives an idea of what part of the steam that gets into the cylinder is used to make the reciprocating parts keep up with the crank pin during the first half of the stroke, when the drivers are making 325 turns per minute. The steam so used is not lost, for approximately the same amount is paid back on the last half of the stroke. Line *1, 3*, represents the force in pounds per square inch of piston area, to balance the reciprocating parts when the engine is making only 165 revolutions per minute, and is comparatively insignificant if high initial or cushion pressures are used. Barring cushion (line *H, 2*, drawn in at random), a very even crank-pin effort may be secured with reciprocating parts of light weight, at moderate speeds, a throttled pressure and later cut-off, as shown by the figure inclosed by the lines *AS, SS, S3, 3I, IA*. With high speeds, to secure an even crank-pin effort, a "full throttle and close cut-off" will be required, and if the cushion line can be made to conform fairly close to the inertia line, a nearly constant pressure may be had on the crank pin, corresponding to about one-third of the initial steam pressure.

The engineer who knows the speed he is running at, the weight of his reciprocating parts, and the distribution of steam at given notches in the sector, ought to be able to gage the distance between the ties and links so as to harmonize the economy of coal and the cost of repairs.

It is not to be understood that the gentlemen referred to above, run their axle boxes looser than they should be. The necessary freedom that a box must have, together with the spring of axle and frame, may cause the driver to slip enough to flatten the tire. J. H. DUNBAR.

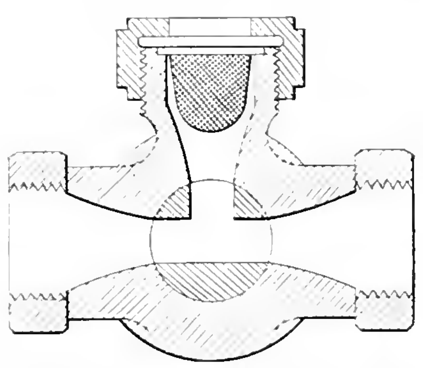
Youngstown, O.

A Cock to Make the Driver Brake Independent at Will.

Editors:

I have been greatly interested in the several letters sent in by L. D. Shaffner, also the one by Will W. Wood, on the advisability of using an independent driving brake in mountain service; also editorial comments on same. Viewing the matter from the standpoint of a practical engineer, L. D. S. seems to have the best of the argument.

While thinking over the matter, it occurred to me that possibly the brake apparatus could, with a very slight change, be arranged so that all parties in the dispute could be satisfied. I therefore submit a pencil sketch of a new style of cut-out cock to take the place of the one in general use in mountain service.



In the sketch as shown, driving-brake auxiliary is supplied through an additional port in cut-out cock, and all brakes operative as at present. By moving handle one-quarter turn to the right you have an independent driving brake, and can bunch train as W. W. Wood suggests. By moving handle another quarter turn, train brake is cut in and set with the same reduction as driving brake. In third position, driving brake remains set while train is being recharged in going down mountain grade, and train held in check.

It sometimes happens that, on a bad

night, brakes all cut in, hose bursts, and driving wheels go to sliding. With this arrangement, by placing handle in position No. 2, driving brake can be released. Placing handle in position No. 4, all brakes cut in on second engine in double heading. There are several other things this cut-out will do, that will be readily apparent to any one familiar with the brake apparatus. The handle on the plug could be arranged with a pin spring, similar to the one in use on the equalizing discharge valves, with suitable recesses cut in the body of the cock, to avoid any possibility of handle falling out of position.

Monett, Mo. C. P. CASS.

Branch-Road Machinists.

Editors:

The requirements of a branch-road machinist are something not thought of by a master mechanic in any other way than of a man to put in a spring, or a rough bolt—to do the bidding of the engineers. But, do they ever think that the engineer is not always qualified to see to it himself? and so the man is selected in a common way. If he can put in a spring and handle a monkey wrench, he is all that is required. So he is installed in his position, and goes at it with a vengeance, and makes a botch of it. It is all right as long as everything goes well, but an engine comes in with a slipped eccentric or rods want reducing. She pounds bad somewhere, but it is not in the rods. Lost shims in guides, got loose on the trip, or the valve and cylinder on the right side groan badly. Monitor breaks, can't work the injector very well, lose water with it. If you make it take water up, it breaks. Checks stick badly. Have to go out and pound them down. And at last we come to the air brake. The pump has stopped on the road, tank brake leaks off. It takes 20 pounds to set them; can't do anything with them, they must be fixed.

With any of those jobs, what will your man do? He will take a hammer, monkey wrench and set. What the monkey wrench won't start the set will. If the eccentric is marked, it is all right; but if it is not, what then? You all know what will happen.

He takes the rods and brasses and don't get them filed square, but they go up just the same, and what is the consequence? Hot pins. He then starts to find the pound, but can't do it; and lets it shake the cab to pieces. When the guides are loose he will shim them too much at the bottom or top. The result will be hot guides or too loose. As for the cylinder, he won't touch that, and you will have cut valve and cylinder. The only thing to do is to go to the shop, and have her valves planed and the lubricator looked at, and she won't groan any more; but what will be the cost? Now comes the water work. He will look the injector all over, but that is as far as it goes; so he will change it or send it to the shop for repairs.

He will fix checks his own way, but they are just as bad the next day. As for the brakes, he will take the wrong thing every time.

I have seen just such a man, who was offered a pretty good job at fair pay, that smashed a globe valve before we could stop him, and it so happened that I had another top to put in its place or we would have had a five hours' job to put in another valve. All there is of those men is rush and tear. I do not mean to say they are all like this fellow, but there are lots of them.

I have told you what he is. Now I will try to tell, to the best of my knowledge, what that machinist ought to be. In the first place, and the most essential point, he should not be an old man. Not because he should be barred out on account of his age, but he is liable to be called at all hours of the night. So you want a young man who is sober at all times, and one that you can find at all times. He should be willing to work hard sometimes because the work requires it. He should be ingenious, because he will have a great many jobs that he will not have time to stop and think about. He should be courteous to all alike, and not show partiality, for it will create hard feelings. If the road uses solid brasses in forward trucks, he should know how to fit them. He should know how to equalize an engine so she will ride good, and have her square so she will look like an engine. He should know how to set valves, if the case should require it—he would know his business; for what is the good of an engine if she isn't square and work as she ought to. He should be capable of taking an injector to pieces and repair it in a mechanical way so it will work. He should be able to take a lubricator to pieces without marring the nuts or breaking joints. I have seen a lubricator after a roundhouse man had put in a glass. He had turned the glass gage so as to get it in that way; but you could not blame the poor fellow, as he did not know any better. He should be familiar with the air brake, so as to take the pump to pieces and put it back together as it should be. If he is not capable, how much damage he can do to an engineer's valve in a few minutes. He should be able to locate a cause for different things that will come up in every day's work that is put in on a locomotive.

A foreman often says: "Fix the thing and let it go; perhaps it will never happen again." That is not the proper way. If something happens up there is a cause for it, and he should know it. When a branch road gets such a man it is well fixed for help. The same should apply to a roundhouse man. Then they would not have to call a shop man every time a job comes in that is a little difficult to handle; and it would pay a road to keep such a man, for he would earn his money every day in the week.

Rutland, Va. A. J. GOSSELIN.

Queer Locomotives.

Editors:

I have just received your issue of January, and notice that on pages 28, 29 you illustrate some compound locomotives, which you attribute to Messrs. Neilson, of Glasgow. The one for the Bombay Baroda Railroad may be, but the two for the Argentine were built by Messrs. Sharp, Steward & Co., of Glasgow, for the extensions of the National Central Northern Railroad (Jackson contract), on which contract I was leading erector, and, among others, I built the "Cosquin."

The passenger engine class were good all-round engines, but the freight class were badly designed for repairing. For one reason, it was impossible to get underneath them without bringing them over a pit, or else taking down some of the brake rigging or dropping the cowcatcher. This is obvious if you examine the photos. The crossheads and guide bars were evidently designed by someone who had never had to line one up in his life, for to do so you had to take down guide bar and crosshead, slip crosshead off the guide bar, line it up (by guess), slip it on again, put up bar, and try it for lining with cylinder. The crosshead was a solid steel casting, with hook-ended brass gibs, and the guide bar was a fixture at the rear end.

This was afterwards altered by W. W. E. Cooper, the assistant locomotive superintendent (late of McComb, Miss., and Tyler, Tex.), who devised a movable brass lining gib, making it possible for us to line up both for wear and cylinder without removing guide bar. One of this class (compound freight) burst her boiler last summer at Tacuman, killing several fitters. The correspondent of the *Engineer* (London) says that "out of thirty odd engines there were only half a dozen that were fit to go out." And these engines were all built between 1889 and 1891, so that there is something wrong somewhere. If you look closely at the name plate on cab, you will see that the name "Atlas Works" is quite plain.

GEORGE W. HINCHCLIFFE.

Sheffield, England.

Making an Emergency and Returning to Lap Position.

Editors:

In reply to W. M. Pipkin in regard to making an emergency application and bringing valve back on lap, we beg to state that he must have tried it with a triple in good order, and in an instruction room at that. But nevertheless, it is a wrong way to handle the valve in making an emergency, and besides, the object of returning the handle to lap is, no doubt, to save air, and not to increase the pressure in the cylinder. For instance, take a train of thirty cars, and make a quick reduction in emergency and return the handle to lap. This starts a rush of air out of train pipe emergency port, and the pressure, being cut off so quickly, increases in the front end of train pipe, and will release the brakes

on two or three cars next to engine. This is, considering every triple in this train is in good order.

Now, we will try this train again, and suppose that there is about eight cars out of the thirty that have leaky check valves, as this amount is not uncommon, for we find them leaking every day. If we were to make an emergency application with this train and leave the handle in the emergency position (where it should always be left), and after a sufficient time had elapsed for the train pipe to exhaust its pressure, the continual blow out of the exhaust port would indicate to you that there were some triples in the train that were not reliable in emergency—where, if you return the handle to on lap, you could tell nothing about them. That is the reason that sometimes a train will hold better in a service application than in an emergency. In making an emergency application, never think of saving air, but throw your handle to the emergency notch and leave it there. That is the reason the Westinghouse people put a large shoulder at the end of the emergency notch, to prevent the handle from going all the way around and releasing the brakes. There are enough positions marked out on the valve now without making any more. The method of returning the handle to lap after an emergency will do for air-brake inspectors to perform in instruction cars, as it saves the air, and besides, they are not going to get into close quarters as we sometimes do on the road.

WALTER C. GARAGHTY.

Baltimore, Md.

A Planer with Wings.

Editors:

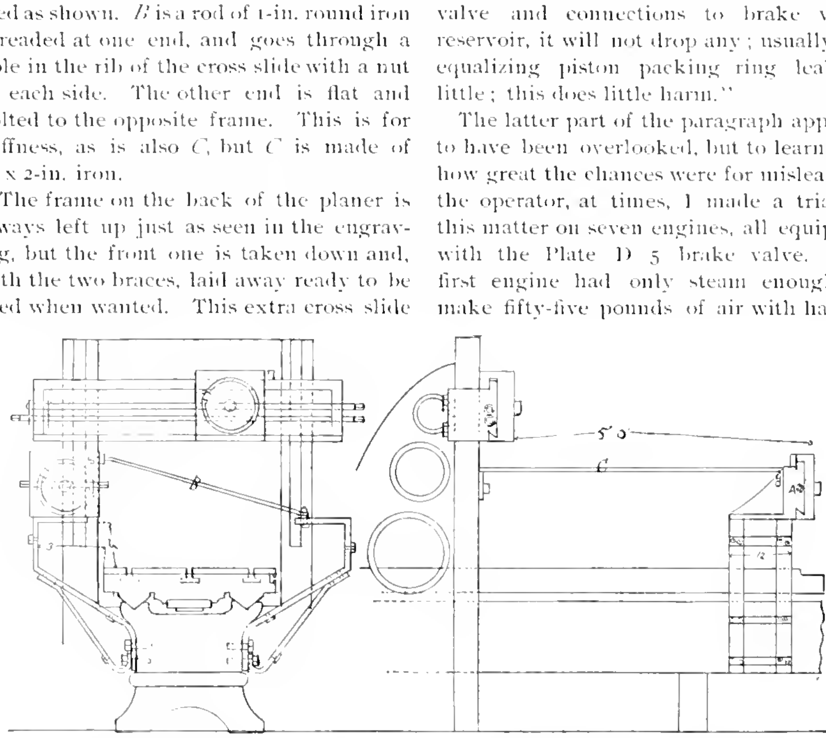
There are tools and attachments to tools that are made, and after being used for a length of time become so familiar that one almost forgets but what they came with the machine to which they are attached, or have been bought by the company, until something comes up to refresh one's memory on the way that the job used to be done.

Lately, being off for a couple of days, and being in a town where there is a railroad shop, of course I went through it. While going around, I came to a planer where they were planing an engine deck or footboard, and as the planer was not large enough to let it pass between the uprights, they were using an arm. Anyone that has ever used an arm will know what kind of a time they were having.

Seeing this, brought to my mind that we used to employ an arm at one time—and what difficulties we used to have with it!—but that day is past. Not that we have a planer now that will let one through, for it is not as easy to get tools here as it seems to have been for Jim Skeevers, but we have put on the attachment that is here shown.

The frame is of 1 x 3-in. iron and braced with $\frac{3}{4}$ x 3-in. iron. There are three cross braces $\frac{1}{2}$ x 2 in., the inside of the frame is 13 in. out from the plates and 9 in. higher. This is enough for any foot plate or engine-truck center casting. There is one on each side of planes, held fast by four 1-in. tap bolts. We then made a short section of the cross slide *A* in the figure, with the base wide enough to bolt to both plates of the frame. We put on this a full-size saddle. The only thing that we left off was the vertical feed, but put in the cross feed as shown. *B* is a rod of 1-in. round iron threaded at one end, and goes through a hole in the rib of the cross slide with a nut on each side. The other end is flat and bolted to the opposite frame. This is for stiffness, as is also *C*, but *C* is made of $\frac{3}{4}$ x 2-in. iron.

The frame on the back of the planer is always left up just as seen in the engraving, but the front one is taken down and, with the two braces, laid away ready to be used when wanted. This extra cross slide



is set out 5 feet in front of the one on planer. It is made exactly the same as the one on planer; so all we have to do is to unscrew the bolts that hold the swing head and transfer it to the new slide, and we are ready for work, and to say that it is as rigid as though the work was going between the uprights is not stating the case too strongly.

This is cheaply made, and the planing of 2 or 3 foot plates will pay for it, and then the man that runs the planer will live longer, as also will the foreman, and both will stand a better chance of going to that place where all railroad men expect to go to when all life's vain troubles pass.

One other little improvement that we have done on this planer was lengthening out the screw in the saddle for the vertical feed. This is the largest planer we have, and the vertical feed was only 7 inches; and when you most needed it, it would be just about $\frac{1}{2}$ inch too short, and of course we would have to take two cuts; and where work has to be finished, it is best done without shifting the tool if possible. So I cut off the journal at top of swing plate, had a forging made, and bolted it to back of swing plate so as to raise it 9 inches, made a new screw, and now we have a feed of 16 inches; and when we want longer than that, we will devise some other way to do it and let you know.

W. A. ROBERTSON.

Cedar Rapids, Ia.

Leakage of Brake Valves.

Editors:

In an article in your April number, the statement is made while commenting on the "Additional Information Catechism," that the black hand on air gage will fall to the peg in a very short time if the angle cock at rear of tender be opened when brake-valve handle is on lap. The answer to question No. 7 in the catechism referred to says: "If there are no leaks in the brake valve and connections to brake valve reservoir, it will not drop any; usually the equalizing piston packing ring leaks a little; this does little harm."

The latter part of the paragraph appears to have been overlooked, but to learn just how great the chances were for misleading the operator, at times, I made a trial of this matter on seven engines, all equipped with the Plate D 5 brake valve. The first engine had only steam enough to make fifty-five pounds of air with handle on lap and angle cock opened. It took nine minutes and fifty-five seconds to leak down to peg. The second, at fifty pounds of air, took five minutes; the third, at seventy pounds of air, took two minutes and fifty seconds; the fourth, two minutes and thirty seconds; the fifth, three minutes and twenty-five seconds; the sixth leaked from seventy to twenty-five pounds in seven minutes; the seventh, the same in six minutes.

Seeing that the valves whose equalizing pistons had not been cleaned lately leaked the least, I took out the piston of the last valve tried, which was the only one that I had time to open, and found the packing ring full of gum or tallow, with a small quantity of plumbago in it, and the cylinder in which it worked had a small ring of this gum on the lower part, just where the piston stopped. On cleaning out, and leaving the piston dry, when trying again after replacing, the black hand fell to twenty-five pounds in one minute and twenty-five seconds. Beginning to think that the valve would at times form an air-tight seat on this gum, I placed a piston so that its outer edges rested on a ring, and put a heavy brake shoe on the center of the top part, while the lower end just bottomed on an iron plate. On removing the weight, the piston would rise clear of the plate. On replacing weight, the plate

would be held fast, from which it appears, that with seventy pounds of air to the square inch resting on the piston, and it supported at the center, the outer edges would spring a little, and might make airtight, while in locating leaks above the piston, unless the lower gasket in the new brake valve leaked, the piston would be nearly balanced, and not touch the gum.

I have seen at various times some apparently very tight packing rings, where in this test the black hand would remain stationary for any reasonable period, even though the air gage was jarred severely, while others have made the same test and obtained results decidedly different, which may, perhaps, be due to the fact that they picked, as a rule, new, clean valves to experiment with. Would like very much to get at the bottom of this affair, as there certainly must be some cause for such wide variations in practical tests.

Would like to ask in regard to placing of leakage groove in bottom of brake cylinder, in Friend Wood's article, what would become of the oil? Would state that during the past winter I found oil frozen so hard in the brake cylinders that brakes could not apply; the mass removed was, as far as I could see, the heavy black oil used in the summer, together with the sediment usually found in such places. In Friend Hamar's explanation to his puzzle, would ask what made the air in train pipe in car No. 1 lower than the pressure in car No. 2, which was presumably leaking as much when the other brake was applied as when it was released?

Roanoke, Va. GEORGE HOLMES.

Notes on Firing.

Editors:

I have read the various articles that have appeared from time to time in your paper in reference to combustion and the proper way in which to handle an engine to get the best results from the fuel consumed. The writers impress one as having made a thorough study of the subject in hand. But viewing it from a practical standpoint, there seems to be something lacking to make them interesting to the average fireman.

Experience has taught me that it is the duty of an engineer to take a personal interest in the fireman, and by degrees lead him to see that by following the instructions laid down by the head of his department, he not only saves a great deal for his company, but makes the work much easier for himself. The best way is always the easiest. An engineer should, after instructing his fireman, be able to take the scoop in hand and prove his assertions. Unless he can do this, the fireman will take very little stock in what he has said.

My theory is that no matter how wise a man may be, if he has not the faculty of imparting his knowledge to those desiring it, he has no possible excuse for ever having been born.

Nothing has ever been perfect, and, as in this case, we must be contented a great deal short of it. To convert as much of the fuel energy into mechanical power as possible should be our chief aim. How can this be done best? I shall mention a few ways by which it cannot be done: 1st. By putting in from six to ten shovelfuls of coal and getting on the seat and riding as many miles. By pulling out of a station with the injector at work, and the links dragging on the ties for two or three miles. With one or perhaps both dampers loose or broken off. Nozzles choked by corrosion, until they are scarcely half the original size. If a straight stack and extension front, with bad joint on front door and center barrel in stack partially or all cut out; and if a diamond stack, with the cone stays broken and petticoat pipe cut out on one or both sides. All of which I have actually seen. Still, there are men in charge of power who raise particular hades with a fireman for using too much coal on tubs of this kind.

I remember once asking for certain repairs in an extension front. The M. M. replied that it was not necessary, that he had known engines to run with center barrel cut entirely out and no diaphragm in, and diamond stacks to run without any petticoat pipe, and could see no difference in the results, and that all a front end was for was to arrest the sparks. To most men this may seem incredible, but it is just as true as that Grover Cleveland ever went duck hunting. Firemen, as a rule, are intelligent men, and when they are reprimanded for not making as good showing as someone else they invariably say, If the company will do their share, I will do mine. Until they do, I don't intend breaking my neck trying to do something impossible under the above conditions.

Now for a few hints on what to do and how to do it. The exhaust steam creates a current through the stack and in the front end, thus forming a partial vacuum. This draught forces air through the grates and supplies the fire with the necessary oxygen, causing it to burn fiercely. Always bear in mind that a large amount of air is necessary to make a fire burn fiercely. Great care should be taken not to have fire too thin when engine is working hard, as it will surely make your steam drop rapidly, caused by the cold air going through the flues and cooling them. Air must be thoroughly mixed with gases thrown off by the fuel, to do any good. Avoid black smoke by firing light; a great amount of smoke is an indication of a waste of fuel. It consists of various gases, water, vapor; air and carbon are the principal parts. The black portion is the carbon, and can be used up to a large extent by careful firing. Hydro-carbon is the first gas thrown off when fuel is thrown in firebox, and were it possible at the moment it is thrown off to mix it with the proper amount of air and keep at a high temperature, it would ignite and burn.

I have noticed firemen on heavy runs that would make scarcely any smoke at all, and they are invariably men who attend strictly to their duties. The other class are known among engineers as seat-box firemen. When you have a very heavy fire, it is almost impossible to get sufficient air to keep up combustion. Never open the door to cool the engine when working, as contraction is so rapid it is very destructive to the flues. Before shutting off, arrange to have the fire burnt out enough to prevent excessive smoke, as this is the most annoying thing the traveling public meet with. A brick arch is a great aid to combustion, and anything that aids combustion prevents black smoke. It also prevents cold air from the door from striking the flues. Railroad companies all admit that were it not for the enormous fuel bills they could declare a dividend occasionally, which fact is quite true, and the man to help them do it more than anyone else is a good, intelligent traveling fireman.

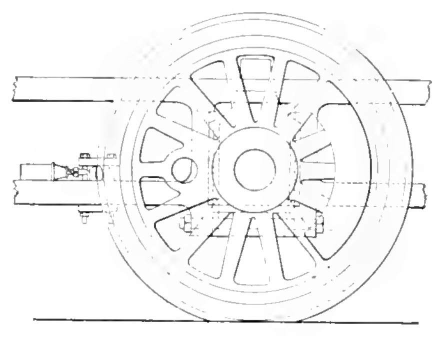
A. L. MOLER.

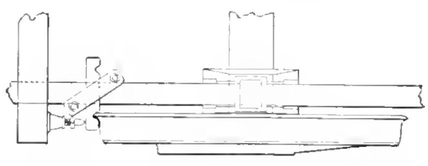
Tupper Lake, N. Y.

A Tool for Turning Flanges When Under the Engine.

Editors:

The question was asked in your paper some weeks ago, if there was anyone who had turned tires under the engines; will say that Mr. William Kelly, master mechanic of Cascade division of the Great





Northern, at Spokane, used the device as shown in sketch for relieving sharp flanges, and it worked very good. I was roundhouse foreman for him for some time at Spokane, and used it on the large consolidated engines, class 38, on that road. This class of engines is used on the switch-back, on the Cascade range, and the tires wear very fast on the flanges, due to the sharp curves, and as the rigid wheel base of this class is 15 feet 6 inches, and backing as much as going ahead, the back flanges cut fast in dry weather. During the winter months, when the rail is moist, they wear longer. In order to make them safe to run, when the flange was worn to 5/8 inch thick, he used this tool to form up the

flange, which it did well, and in a very short time, by selecting a good, level and straight piece of track, and clamping the tool on the main frame, as shown in Fig. 1, using a small jack to feed it on the tire with.

We have formed up a pair of tires in two hours' time; in doing this would make the engine run for three and four months longer and sometimes a year, by changing the engine on another division, where the track was straighter.

The cost of the tool is a small item, and the saving is great. The tool is made so it is right and left, by forming a flange tool on each end of the 2-inch square steel, and in using, the wedges must be set up tight, and the side-rod keys loosened upon the pin in the wheel that is being turned.

If you will give it mention in your paper you will oblige me and show up a tool that will pay for itself in one day; for, on the mountain roads, engines have to be taken out of service for sharp flanges before the other parts of the machine require repairs.

A. G. Ramsey,
Davenport, Ia. C., R. I. & P. Shops.

Effects of a Dry Eccentric.

Editors:

I wish to ask what I consider a very important question. Perhaps you or some of the readers of Locomotive Engineering can enlighten me. A short time ago, while out firing on a heavy goods train and about to pull up at a station, without the least warning of any kind the reversing lever started to tremble. A grunting and groaning of dry piston and valves, which a good many of your readers are well acquainted with, took place. I had the brakes applied and the train was about to a stand-still. The driver put his hand on the latch of the reversing lever. The lever flew back like a shot from a cannon, hit him on the right breast and laid him out like dead—in fact, I thought him so for some time.

At the same time, there was a great commotion underneath the engine. After getting my mate to his senses again, I examined the wreck, and found the left-side go-ahead eccentric sheave had seized, and the eccentric rod had broken off close to the strap, was bent like a bow, and had bent the back gear one, too.

Now, what I want to know is, What made the lever fly back? Mind, the engine was going ahead. I have an idea that when the go-ahead sheave seized, the back gear one took the control of the link, and that's what made it come back. Am I right, or wrong? Perhaps some of your readers can enlighten me. Frank Auschan.

Maryborough, Australia.

Tube-Sheet Stays Are Old.

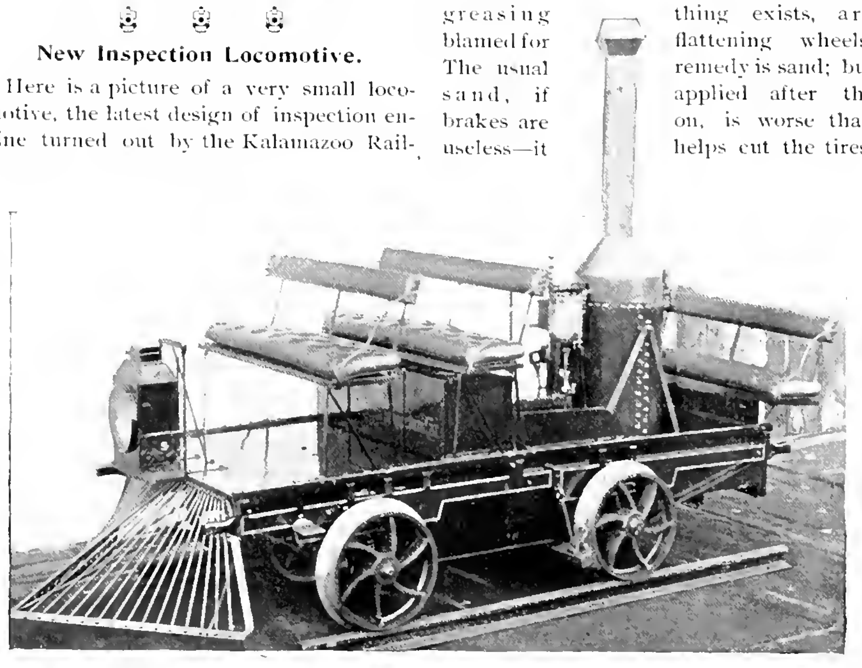
Editors:

In your April issue, Mr. E. Dawson, at present master mechanic of the Des Moines & Kansas City R.R., but formerly assistant master mechanic of the F. E. & M. V., takes credit for having introduced the long stay rods, running from front to back flue sheet to prevent flues from leaking, on the F. E. & M. V. in 1893. I wish to correct this, as it was my suggestion to him at that time, as a temporary relief to a few engines that were out of shops a considerable time, and, by the use of the long stay rods, would in a measure assist the flues, and thus enable us to keep out engines until we had an opportunity to take them into back shops for general repairs. This stay rod, however, is not a new scheme, as I have seen it used on one or two engines on the B. & M. R.R. in Nebraska some seventeen years ago, under the instructions of Mr. D. Hawksworth, superintendent of motive power for the same purpose—namely, temporary relief.

M. O. Connor,
Foreman Boiler Shop,
Mo. Valley, Ia. F. E. & M. V. R.R.

New Inspection Locomotive.

Here is a picture of a very small locomotive, the latest design of inspection engine turned out by the Kalamazoo Railroad Velocipede & Car Co., of Kalamazoo, Mich.



Kalamazoo Steam Inspection Car.

The engine carries six to eight men and will make from twenty-five to thirty miles an hour on level track, carrying fuel enough to last half a day; the engine is five horse-power, reversible, and the whole thing only weighs 1,500 pounds, the weight being so distributed that two men can get it off the track very readily.

These cars are in extended use for roadmasters, bridge builders and line inspectors.

One of the most horrible forms of railroad accident, that often kills or mutilates switchmen and others, is getting the foot caught in a guard rail or frog, where it is held locked while the car wheels run over the owner. There is no excuse for this trap being left open to perform its deadly work, because filling the seat of danger is a simple and inexpensive matter. Several State legislatures have passed laws requiring the frogs and guard rails to be filled, but yet thousands of them remain open. The usual plan has been to apply wooden filling, which soon shrinks and falls out, leaving a trap where trainmen had come to believe there was no danger. We have lately seen in several yards a steel foot guard, made by the National Foot Guard Co., Columbus, O., which it would pay railroad companies to apply in place of the unreliable wooden filling. This guard is inexpensive, and, when once applied, is as permanent as the frog itself. We have not examined any railroad improvement for years which we consider so thoroughly worthy of general adoption.

Many engineers who are obliged to make quick stops at stations where a muddy road crossing, or some other similar wheel-greasing thing exists, are blamed for flattening wheels. The usual remedy is sand; but sand, if applied after the brakes are on, is worse than useless—it helps cut the tires. The true remedy is sand, but applied before the brakes are used. Once the sand is under the train, the brakes will take hold, and do effective braking without skidding wheels.

During February and March there were ninety-three sets of Leach pneumatic sanding apparatus put on locomotives. Sixty of these were put on new engines by builders. This would indicate a tendency to the belief that this device is becoming recognized as a necessary part of a locomotive.

All the answers to the Traveling Engineers' Form of Examination Questions will be printed in our June issue.

Conducted by Orville H. Reynolds, M. E.

Lower End Doors in Freight Cars.

The lower end doors of the average stock car, and box as well, are frequently an interesting study when considered in the light of what is aimed at and what is attained in the way of security and accessibility.

The matter of convenience in loading is easily settled, but not so the other and equally important one of how to make lading secure and keep the tourist out; and to accomplish this, recourse is had to heavy hinges and straps, so massive in many cases that they bring up visions of moated castles, portcullises and things—an adaptation of means to ends which again proclaims that the man who is not afraid of dead weight is still doing business. This was made disagreeably patent not long since when we saw some end doors having two hinges 4 inches wide, ⅜-inch thick and 10 inches long over all, in combination with two 2-inch by ½-inch by 8-inch straps at lower end (the latter forming bars to prevent opening), and a hasp and staple, together with a pin and chain on the outside; the whole secured with ½-inch bolts and plenty of them.

This completed the picture of the smith's art on one door—it would excite the cupidity of any tiller of the soil who needed those hinges for a new granary.

The best, cheapest and simplest method of hanging these doors that has come under our observation is shown in the illustrations. These doors have stood the buffetings of the hardest service for several years without demanding any serious outlay for maintenance, because there is nothing to maintain—when applied that ends it.

There is no need of a seal on these doors, as they can only be opened from the inside. Fig. 1 is the arrangement for stock cars. They are hung from the lower side of girth by two 1¾ x ⅜-inch strips of wrought iron, which are secured to the door by two ½-inch bolts passing through each piece and riveted over nuts on outside. The top ends of these strips have a ¾-inch hole engaging with a ½-inch bolt which passes through the girth, and this bolt is also riveted over the nut on the outside. The inner ends of these bolts are bent U shape, and the short end sunk ½ inch into the girth, forming an eyebolt in the cheapest manner possible, for the door to swing upon.

The posts are rabbeted ½ inch deep to within 1¾ inches of the outside face, making a shoulder for the door to abut against. At the bottom on the inside face, in the center of width of door, is the lock; this is

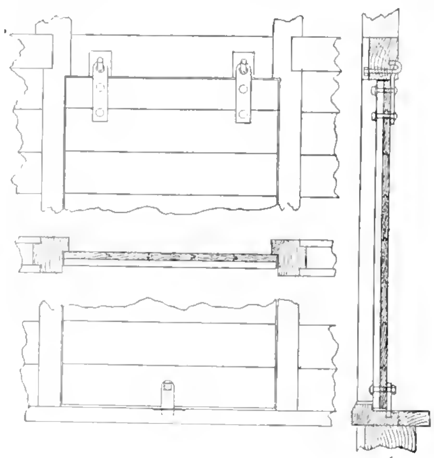


Fig. 1.

made of ½ x 1½-inch iron, secured by one ½-inch bolt passing through door and riveted over nut on outside, the lock swinging on this bolt, and the flooring is cut away to allow it to bear against the edge of a ⅜ x 2-inch plate which is let into the flooring. The lock is slightly

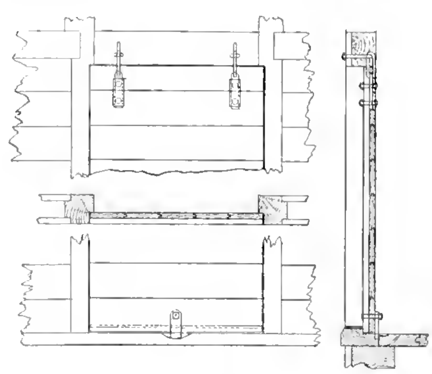


Fig. 2.

tapered on the lower edge to allow it to be forced to place, thus insuring a tight joint between the door and posts.

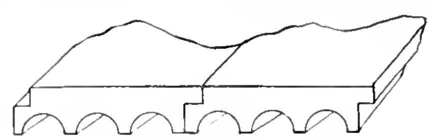
The doors for box cars are nearly identical with those described above, the only difference of note being in the construction of the hinges, which, on account of the character of freight, it was necessary to make, so that when the doors were closed they would have a flush surface to prevent injury to any load in transit.

Fig. 2 explains this fully, in which it is seen that the doors are hung from girth as before, and suspended by eyebolts also, but these eyebolts have their heads in a horizontal plane in order to engage with a ⅜-inch link, the girth being gained to receive both bolt and link, the latter of which connects at its opposite end with a strap ⅜ x 1 inch, which is secured to the door in same manner, and has same locking device as in Fig. 1.

These popular end doors were designed by Mr. Edward Passon when chief draftsman with the M., L. S. & W. Ry.

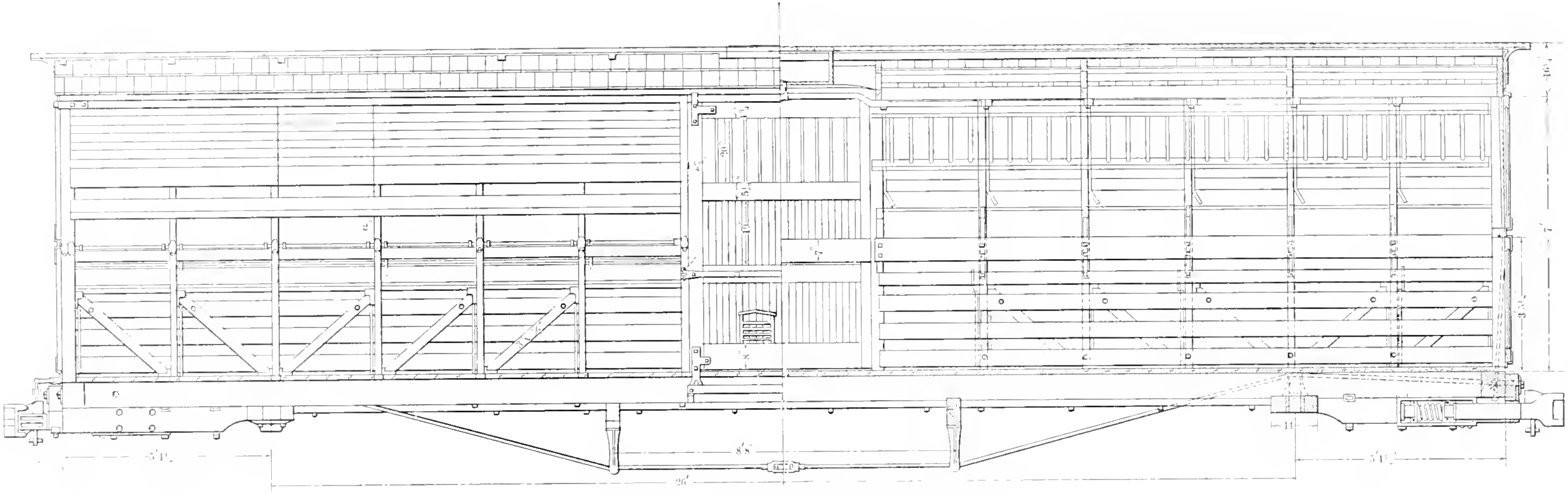
New Stock Car for the C. & O. R.R.

This stock car combines maximum carrying capacity coupled with minimum dead weight, to an extent hardly equaled by any stock car we have had the privilege of examining up to this time. When a car body, 36 feet long, carrying 60,000 pounds of lading, the complete car weighing under

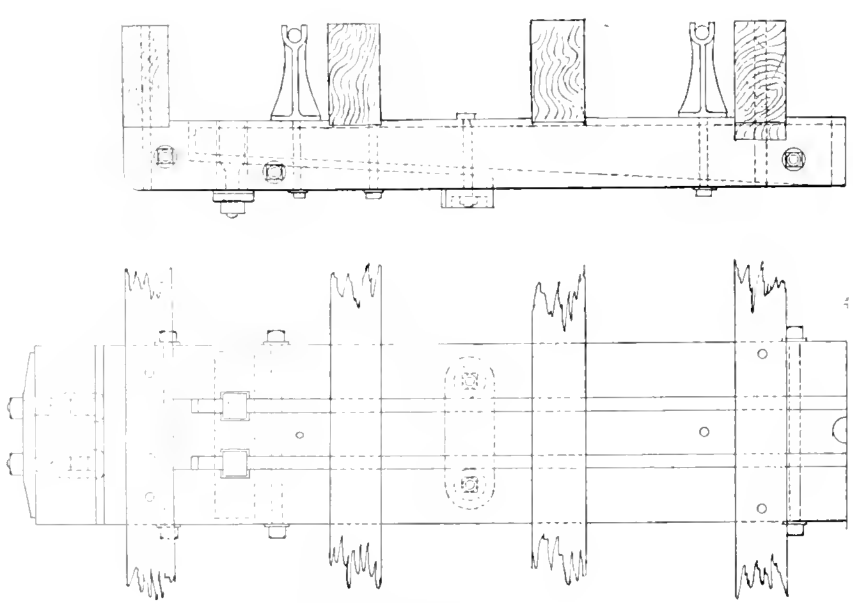


Gained Flooring.

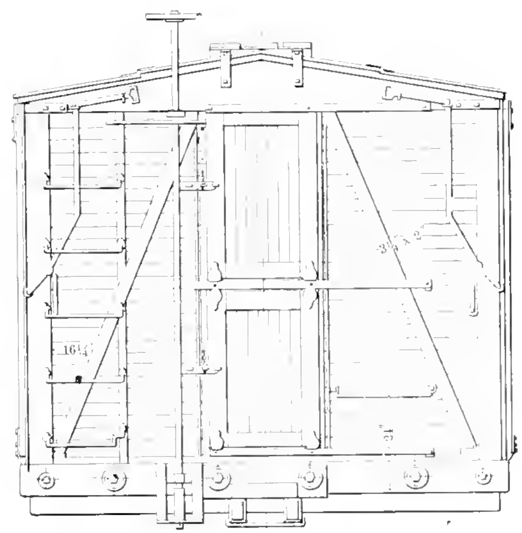
27,500 pounds, at the same time having a high factor of safety, is produced, it certainly shows good designing; but when this is done without introducing expensive fads or calling for such materials or shapes as would bring the cost above that of ordinary construction, it shows careful attention to the minutest details. The car provides for hay racks and feeding troughs for feeding the cattle in transit. A central tank in the roof is so piped that all the troughs fill simultaneously when the water spout from a wayside tank is let down into this supply tank. By a simple and ingenious method, both the hay racks and troughs can be housed, and the side slats made to close, so that the car can be utilized for carrying merchandise or coal. The most important reduction in dead weight is caused by cutting out a space in the center of the carlines, 45 inches long, 5 inches wide at the center, and 4 inches wide at the ends, gain-



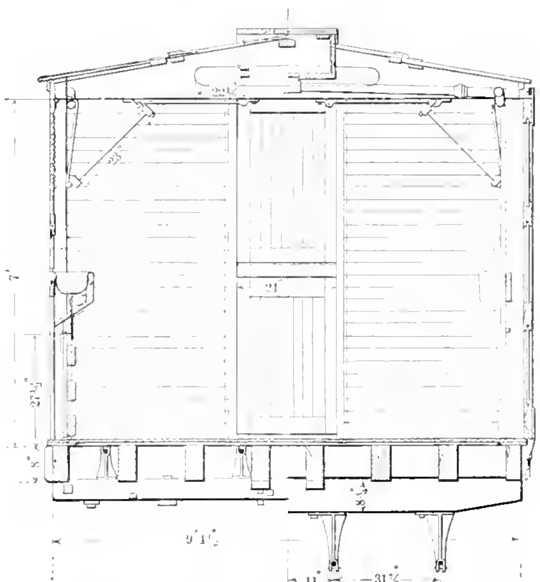
Details of Framing C. & O. Stock Car.



Details of Body Bolster.



End Elevation.



End Section, Showing Feeding Apparatus.

ing of the slats on the sides, and the under side of flooring—three gains being used to each board. This method applied to under side of flooring makes an air space of great advantage, when the kind of lading is considered. Attention is particularly called to the trussing, and the depth of the truss, which is, including the needle beams, 20 inches.

Fig. 2 shows a novel form of putting up the body bolster. It is what is known as the sandwich form, with three timbers—$4\frac{1}{4}$ inches, $3\frac{1}{2}$ inches, $4\frac{1}{4} \times 5\frac{1}{4}$ inches, respectively—between which are plates 1 inch wide by $5\frac{1}{4}$ inches deep at the center, tapering to 2 inches at the ends. The ends are gripped by straps of stirrup form, ending in a threaded stem and nut projecting below the timbers, of a sufficient length to admit of a good, liberal washer, having a bearing across the whole width of the bolster. When the bolster, from any cause, sags, a few turns on the nuts will bring the bolster back to place, and maintain the proper relation between the bolster and truck.

Mr. Morris, the S. M. P., is to be congratulated on the results produced, and no doubt the tests of service will prove very gratifying.

Journal-Box Covers and Dust Guards.

With a zeal that is worthy of an important cause, the matter of hot boxes and the reasons therefor is ably handled by men who know whereof they talk—men who will trace effect from cause with an unerring skill, only acquired with the mellowing years of experience. They command the respectful attention of all by giving up their wealth of lore to the newcomer, who is filled with a burning desire to do or die when facing a problem that has brought unrest to stout hearts.

Learned dissertations on the kind of material for packing, and how to dispose of same in the box, viscosity and other features of the lubricant, the character of the alloy in the bearing, if solid, and proportions of the soft filling or lining, if either is used, are old stand-bys, and are thrashed over periodically. This much for the interior of the box, with a view to prevent a carnival of heat units. It is all educational, but what about the exterior of this same box; has proper attention been given it—to keep oil in and dirt out? The appearance of boxes on most of the cars in freight service would unquestionably furnish an emphatic negative, for an honest review of the situation will reveal few journal boxes with covers that approach even an approximation to a proper fit, and by proper is meant a joint close enough to make a reasonably tight box.

Some roads make only a bare pretense to this end, notably those using the vertical wedge cover, which is a miserable makeshift, to be depended on only to lose itself out of the box; probably the best use it could put itself to, for, in that event, a wooden cover is improvised, which is at least better for the purpose than the rattler it displaces. Never a fit in the box, this cover stands as about the poorest representative of its kind; however, any cast cover, put into a box with no fitting done other than taking off the sand and lumps just sufficient to let it into place, can be nothing but a rank failure. There are few of them that make the slightest claim to keeping foreign matter out of the box, something they ought to do if they have any excuse for a place in car construction.

It should be unnecessary to waste time and space to call attention to the evils following in the train of these ill-fitting covers, they are too plain to need repetition; but suppose those responsible for their use were approached with a few eye-openers like these: "An introduction of gritty matter into the journal box, no matter how slight, will raise the co-efficient of friction, thus causing an increased train resistance, and this in turn greater fuel consumption." Would it have the effect of calling for better work on the box and cover? In the light of our experience we think not.

Trued surfaces on box and cover, and the latter heavy enough to retain its truth, despite the mauling of inspectors and oilers, are the points to satisfy the conditions for the outer end of box. The inner end must receive equal attention, in having a dust guard that will do as effective work as the ideal cover. Do we find such a dust guard in actual service? Well, hardly. What we are confronted with is a piece of thin, soft wood, made to slide in the slot provided for it in the box; no fit is possible between the wood and box, because the walls of slot are just as they were cleaned at the foundry. This leaves plenty of room for dirt to enter, even if top of slot is plugged after guard is placed in the box, for it can enter from the rear and work around the wood.

The one other place to look for trouble is the hole in dust guard. This is the place that has received most of the attention of the revolutionists, but none of them appear to be impressed with the importance of a close fit of guard on the axle, some new samples examined recently showing $\frac{1}{8}$-inch clearance at this point. It would require the license of a poet or a prevaricator to call that a dust guard.

These crudities are made because there is a market for them. The price is as low as the quality of the goods. Cost being the controlling factor, the wretched apology is forced on unwilling hands, to contribute its share in keeping operating expenses up to high-water mark.

Passenger cars are more fortunate in the matter of journal-box covers, particularly those using the cast-iron cover fitted up with a plane surface, but they are suffering from the same ills as the freight cars, with reference to dust guards. The situation calls as loudly for relief in one case as the other. It would seem that the past had furnished enough hard lessons to teach the utter uselessness of the 3-cent wooden article, but they are bought and the grind goes on.

The same attention given to the outside of the box that is devoted to the inside would retain the oil where it could do the most good, and effect no mean saving in lubricant now going to waste. The appearance of the boxes and wheels covered with grease (at 18 cents per gallon) show a laxity that is hard to find an apology for, and it certainly looks strange, when it is known that every possible care is taken to educate the engineman to an economical use of oil, that no special effort is made to stop the leaks in the places indicated. When there is more oil outside of a box than inside of it there is room for improvement. A dust guard made of flexible material, something that would hug the walls of the slot or pocket in the box, and also bear on the axle and have enough elasticity to retain its bearing, would be very near the proper thing to come within the meaning of our claims.

These proposals for improvement are nothing new; they bob up serenely at stated intervals, and will continue to do so until the cause is removed. To fit up journals and their bearings on mechanical lines, leaving nothing undone that experience suggests to have them run cool, and therefore with least resistance, and then to deliberately invite disaster by the use of covers and dust guards that fail of their purpose, does not impress one as an exhibition of profound business sagacity.

The Westinghouse automatic air brake was first applied to a train on the Philadelphia & Reading. The then general manager did not like the straight air brake, and was inclined to adopt the Smith vacuum, when Mr. Westinghouse mentioned that he was working on an automatic brake. The Reading people then decided to wait, and they found the automatic brake so satisfactory that it was at once adopted.

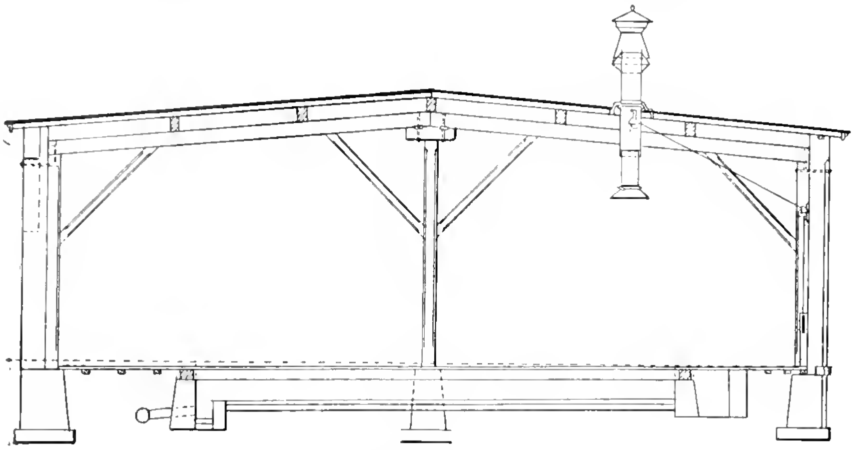
A report has been published to the effect that steel tubes put into some of the boilers of the United States cruiser *Chicago* were riddled with corrosion within forty days after being put into service. Charcoal iron tubes put into other boilers of the same vessel at the same time are still considered good for five years' more wear.

President Hill, of the Great Northern, has made public the statement that the Government mails are carried cheaper than coal.

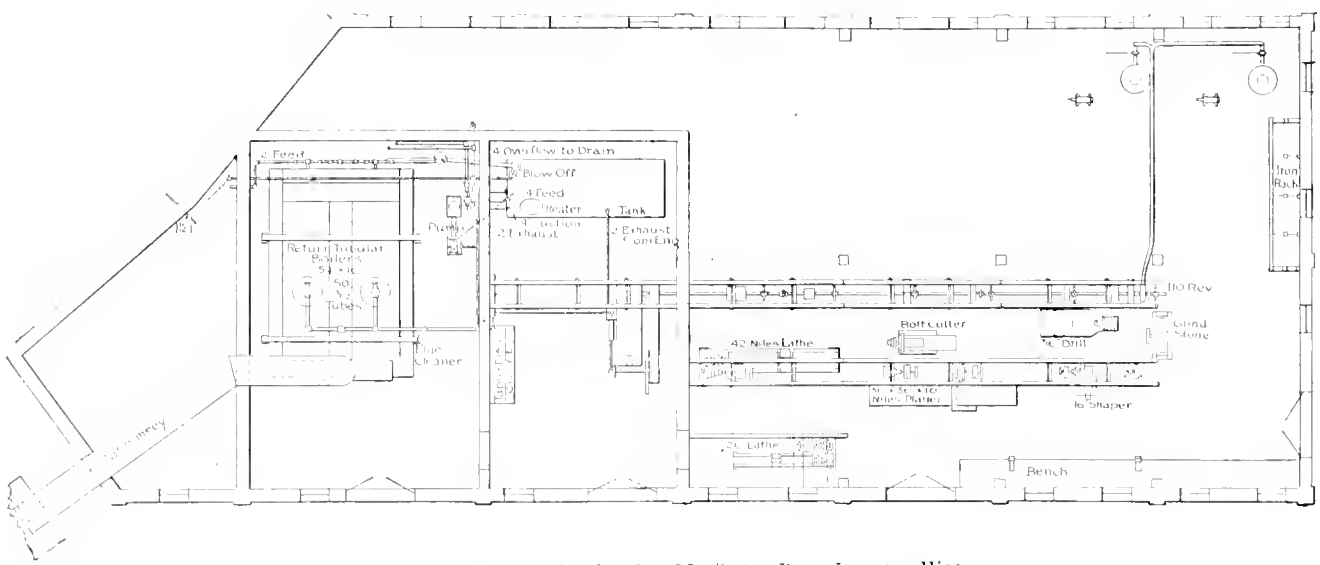
Those who are painting freight cars with brushes are far behind the times for time and cost; air is the great paint brush of the day.

A Model Roundhouse and Small Shop.

There are few roads in the country that put up better roundhouses and shop buildings than the Chicago, St. Paul, Minneapolis & Omaha, and, we might add, supply them better with tools. They have recently completed a division plant at



End Section of Roundhouse.

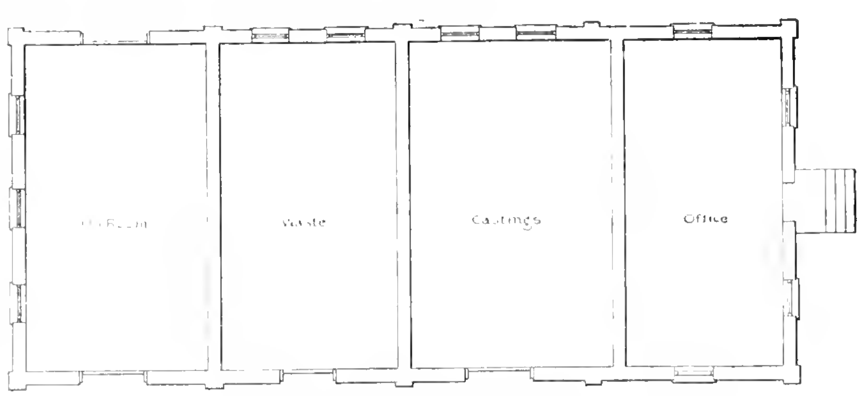


Machine Shop, C., St. P., M. & O. Ry., Itasca, Wis.

Itasca, Wis., that is a model in its way. The buildings are of brick, the forty-stall roundhouse (not all complete) is built on a plan that can be heated, and the pits so arranged that work can be comfortably done from them.

The front view shows the arrangement of doors and end view of pit. This pit deserves especial mention; it can be better seen in the end view of the house. The floor is arched with brick on a solid concrete foundation, so that repairs are always easy. Water runs to the sides, and leaves a dry place for men to work. There are cross pits at the ends; one to the sewers, and the other containing the piping of water, etc.

The engines head in, giving room at the front where most needed for repairs. The floor of the whole house slopes toward the doors 6 inches, so that there will never be any pools of water around. The pits are 40 feet long and 30 inches from floor to base of rails, and 42 inches wide.



Office and Store House.

The smoke-jacks telescope, and the roof is nearly flat; this makes an easily heated house, and is an item of importance in a cold climate.

In all roundhouses of this road a large steam pipe runs around the house just over the domes of the engines, at which points there is a T and globe valve. When they blow off an engine, they couple a steam hose to this and to a globe valve and nipple placed beside the pops on every engine, and blow off into the pipe. In winter this steam is carried through the heater loops in the pits and heats the house, and finally goes to a large tank (shown in the plan of machine shop), where it heats the water used for washing boilers; it can be blown direct to the tank or out into the atmosphere, at will. This is a 1,000 per cent. improvement on the usual ear-splitting, dirt-spreading plan of putting a washer in the whistle and "howling them off."

The ash and clinker pit is a model. It is built high, the track standing up on iron supports; the sides are open, and a solid brick paving gives room to get ashes out to the side and away from the pit regardless of whether engines are on pit or not, and the side is high enough to facilitate loading into cars on a lower track.

The shop is 47 x 100 and divided up as shown on plan. A neat little machine shop occupies about a third of the building; there are an ample smith shop, boiler house, engine house and tank room, all under one roof.

There are enough tools to do the running repairs on a lot of engines, the policy of the management being to do all the rebuilding at the main shops.

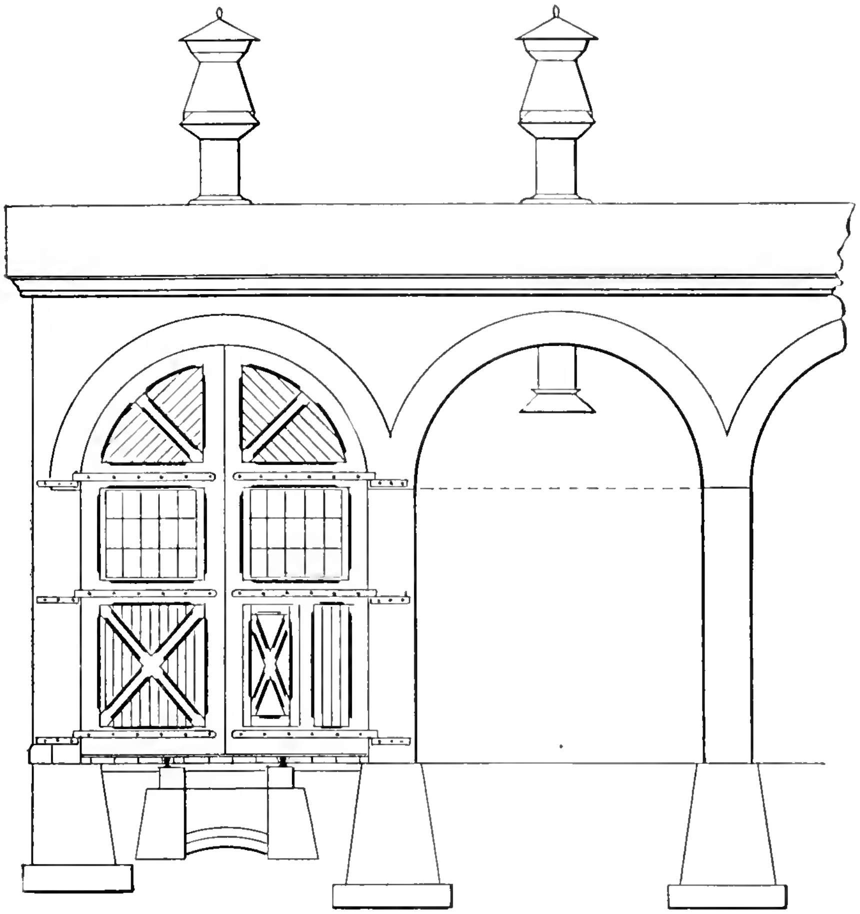
Mr. J. J. Ellis, the superintendent of motive power, pays especial attention to these outlying plants, and especially to means of boiler washing and other items that go so far to keep engines in service.

Discipline Without Punishment.

Superintendent J. F. Angel, of the Toledo & Ohio Central and the Kanawha & Michigan, adopted the "Brown" plan of discipline some time ago. Instead of suspending men for every light offence, they post the circumstance on a bulletin board and enter the charge in a book. This has worked wonders in the *esprit de corps*, and the operating officials were so well pleased with it that they determined to ask the opinions of the men. This was done by a circular letter asking written replies. The following characteristic reply was received from an old-time engineer :

"In regard to me giveing my opinion of the too sistems of dealing with *Bad Luck* It is purthy hard to tell for one is as bad as the other. In the old way when we was not doeing much a man got from 7 to 15 dayes for a verry light case. The new way does away with that. In the old way a man does a lots of little cases that the company does not notice. In the new way every thing he does gowes on the board. In the new way when a mans leef is full he is a goner.

"I dont care how good a man is his leef will get full sooner or latter. When a man is dismissed he asks a man for a job, he will want to know what was the matter, you will tell him your leef is full then 9 out of 10 men will think you are no good. In the old way when a man wants to know what is the Trouble, all you haf to tell is the Last case you had. I think a man has a much larger Leef in the old way then he has in the new way. Some is kicking on account of there cases Posted on the Board to the Public. I would sooner have my case Posted on the Board then to have it posted in the yard masters office, for there is no *Publicer* Board than the Gang that gather there to spread the news, there the case is cut and dried and all over town long before it gets to your office. In the old way a man has not got a full Job for if he has not got Excelent Luck he is off about $\frac{1}{3}$ of his time. In the new way when a man gets a Job he has a full Job for he can work all of the time while he is here. The old way only gives you $\frac{2}{3}$ of the time. So I Prefer the new way—I can work all the time if I dont stay so long."

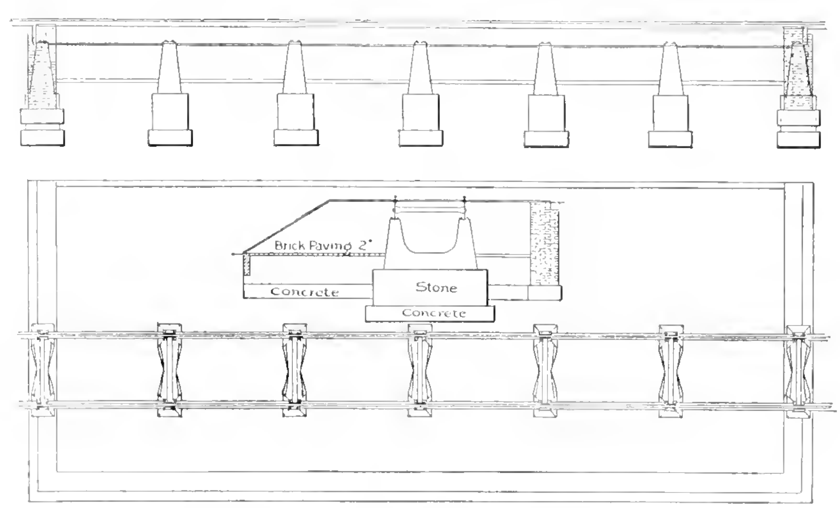


Roundhouse Front.

The Traveling Engineers' Association have sent out a circular asking for answers to the question : "When traveling engineers are also air-brake instructors, how can they best instruct and examine the engine and train men without the use of an air-brake instruction car or room?" Fourteen questions are asked, which, if properly answered, will give valuable information to the committee. Mr. Geo. Holmes, Roanoke, Va., is chairman.

Metallic rod packing for air pumps is a great success, saving time, money, and delays. There is no excuse for using fibrous packing either for the steam or air cylinder, they quickly get hot, become hard, score the rod and heat it. Evidence was abundant at the recent meeting of air brakemen, that this improvement had everything in its favor and nothing against it.

Lackawanna Lubricating Co., Scranton, Pa., have published a pamphlet lately on Locomotive Cylinder Lubrication. It gives practical information about lubrication, which every man in charge of a steam engine ought to be familiar with. If enginemen would study this pamphlet carefully, we feel satisfied that it would bring about a great saving of oil, which could be done without making machinery suffer for want of lubrication.



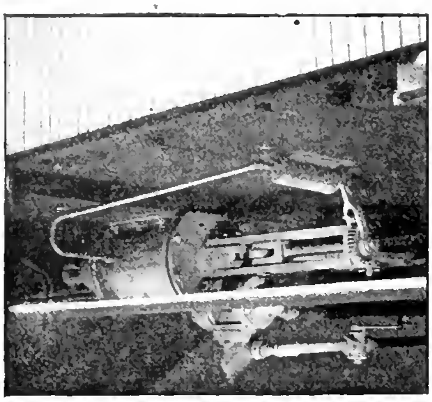
Plan, Elevation and Section of Clinker Pit.

Railroad men who use veneers will be interested in a pamphlet issued by the Nichols Patent Veneer Dryer Co., concerning a method of drying veneers which they have in use. Those interested in the matter can obtain the pamphlet by application to Nichols & Howard, 257 Broadway, N. Y.

The McKee Slack Adjuster.

The brake adjuster illustrated in the accompanying engravings is the invention of Mr. M. E. McKee, of St. Paul, Minn., and is being manufactured and introduced by the Q. & C. Co., of Chicago.

This device embodies several novel features, the principal one being the use of an auxiliary or take-up cylinder, actuated by air from the brake cylinder, which supplies the requisite power, and a screw-threaded pull rod and ratchet mechanism,



McKee Slack Adjuster.

by which the cylinder or floating lever, as the case may be, is adjusted in position.

Several forms of this adjuster have been made, but the one illustrated has been proved by experience to be the most practical and efficient, having been in use on the Great Northern Railroad for the past three years.

Our engraving was made direct from a photograph of the adjuster on the sleeper "Seattle," and is the form used on passenger equipment.

If it is desired to maintain a piston travel of, say 7, inches, the cylinder is tapped at that point, and a $\frac{1}{4}$-inch pipe screwed into it. This pipe connects to a small cylinder, with the usual leather-packed piston. Should the main piston pass the hole tapped into it, air is admitted to the small cylinder, and its piston makes a stroke, moving the lever shown connected to it. This lever carries a pawl that engages in a ratchet wheel, which is threaded through the hub and screwed on to the stem of the jaw carrying the end of the cylinder or floating lever. One stroke of the small piston takes up $\frac{1}{32}$-inch slack at the brake beams.

When the brake is released, the air from the take-up cylinder escapes through the back head of the brake cylinder, and the piston is forced back by a spring into position for another stroke. It is obvious that the brake piston can be adjusted to any desired travel by varying the location of the port by which the $\frac{1}{4}$-inch pipe enters the brake cylinder, and that once the length to which the stroke is to be adjusted is fixed, it cannot be altered by any tampering with the adjustment.

For freight cars the adjustment is made at the end of the floating lever, and the threaded rod and jaw working in, and taking the place of the floating lever fulcrum—the method of operation being otherwise the same as the passenger equipment.

The McKee patents fully cover all methods of adjusting the piston travel by the use of air, and after three years' careful experimenting, the form above illustrated has been adopted in preference to all others, on account of its advantages of simplicity, decreased cost—both for application and maintenance—its comparative immunity from dirt and snow, and get-at-ability, which have been found to far outweigh any theoretical advantage from taking up the slack at any other point.

In addition to this the strain to which the adjuster is subjected is entirely independent of the braking power, whereas with an adjuster applied to any other position the requisite strength must vary considerably with the leverages employed. Since only $\frac{1}{32}$-inch slack can be taken up at one application of the brakes, there is no liability for the piston travel to be shortened by an emergency application to such an extent that binding of the shoes on the wheel while running might occur. It is a well-known fact that this fault is a common one with other types of adjusters, which have given considerable trouble in this respect.

No practical objection whatever has been found in three years' regular service, against adjusting the piston travel at the cylinder lever, or for freight cars at the floating lever. This device has been running both on short-distance and transcontinental trains, in the latter service having been through snow blockades in the Cascades, and the sand and dust of Northwestern summers of the Dakotas, and have so far never cost a cent for repairs, or failed to perform the work in any particular. There is nothing in this device which is liable to get out of repair, the only part ever needing renewal being the packing leather in the small cylinder, and this has not been the case in any of the adjusters so far in service.

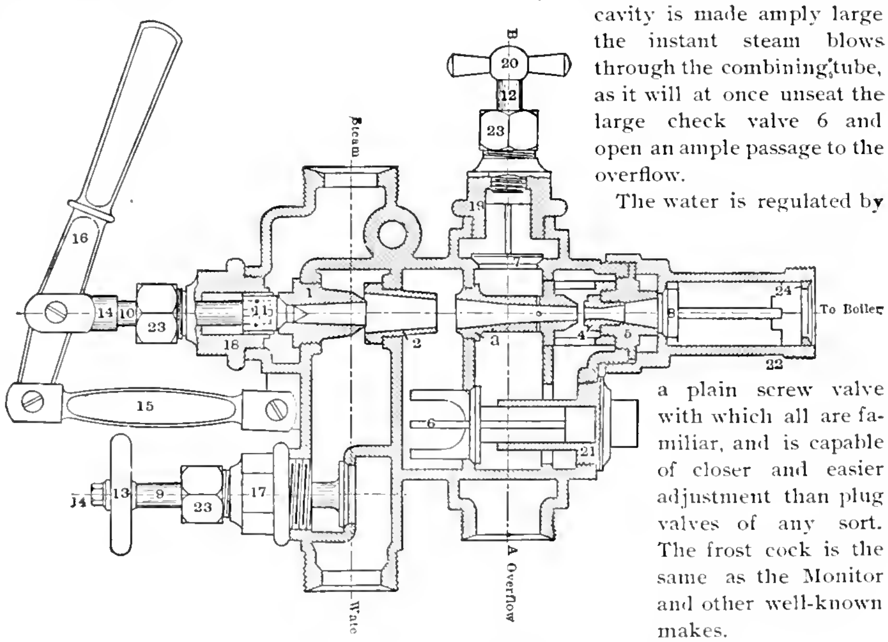
A New Single-Tube Automatic Injector.

The sectional cut shown herewith will make plain the construction of the automatic re-starting injector, now being manufactured and sold by the Automatic Injector Co., of Springfield, O.

As will be seen, this is a single-lever operated device of the standard pattern, but its construction shows several improved details.

The discharge nozzle is the part of an injector that first cuts out, changes the capacity and range of the injector, and calls for repairs. This vital part of this instrument has a separate, removable nipple which can be taken out, and a new one substituted for a few cents.

In all re-starting injectors enough cavity must be provided in the instrument to take care of all the steam that flows through, when the injector breaks, so as to prevent its backing up into the water supply; once it enters there, there is no chance to lift water until the instrument is shut off and started by hand. In this instrument this cavity is made amply large the instant steam blows through the combining tube, as it will at once unseat the large check valve 6 and open an ample passage to the overflow.



The water is regulated by a plain screw valve with which all are familiar, and is capable of closer and easier adjustment than plug valves of any sort. The frost cock is the same as the Monitor and other well-known makes.

The makers claim that the instrument will start with 25 pounds of steam and work faithfully up to 200.

Any further information can be obtained by writing the makers as above.

A few bound volumes of 1894 on hand—no loose copies of the year at all. Price, $3.00, postage paid anywhere in North America.

The next issue of Locomotive Engineering will contain more than fifty pages of reading matter.

Locomotive Tools.

At a recent meeting of the New York Railroad Club, Mr. A. E. Mitchell, superintendent of motive power of the Erie, gave a talk on locomotive tools, which excited considerable discussion and elicited opinions from a number of master mechanics, of how best to deal with the question of holding all the tools necessary upon an engine while keeping down the high expense often caused by tools being lost or stolen. In the course of the discussion, it came out that the expense of keeping up locomotive tools varied from $1 per month on certain roads to $2.50 on others. As the plan adopted by Mr. Mitchell provides all the necessary tools at a cost of $1 a month, and is the most practical way of keeping control of the tools that we have heard of, we quote what he said:

"On a great many roads, engineers, on leaving the terminals, do not know what tools are on their locomotives. The majority of us have tool inspectors, whose duty it is to examine each locomotive at the terminal, before leaving, to see that the proper tools are on each locomotive. But, after an inspector has inspected the tools and found them correct, it often happens that a tool is not on that locomotive when the engine leaves the roundhouse. The practice, also, is to lock tools in tool boxes. But we all know the common practice is to break the lock, if a key is missing and anybody wants a tool. Therefore, it is difficult to know absolutely that the tools are on the locomotives, even if the tool boxes are padlocked when the inspector made his examination. We took up the subject on the Erie about two years ago to demonstrate what tools are absolutely necessary on a locomotive, and we made our examination by riding on locomotives and ascertaining exactly what tools were used by the engineers, and such tools as were not used we thought it advisable to leave off. When we had arrived at what tools we thought were necessary, we made boxes with wire netting fronts, and have them now running on one of the divisions of the road quite extensively. There is a place in the box for every tool.

"The engineers on this division are glad to assist us in this work. When the engine arrives at a terminal, they report a missing tool on the work-slips in the same manner as they would any defective portion of the engine, and the duty of the repairer of the engine is to see that the tool equipment is made good. On this division the engines are assigned regularly to men, so that each man knows the tools on his locomotive at all times; but in case we run two men on one locomotive, they work in harmony together. The engineman becomes his own inspector, and he inspects as carefully for a missing tool as he would for defects on a locomotive. If certain men require more tools than others, that is a question which we require the road foreman to look into. Thus far we have had only one or two cases where a road foreman was obliged to investigate why a certain locomotive engineer was assigned more tools than the others. As to the location of the tool box on the locomotive, the committee I appointed on the subject decided that the proper location would probably be on the running board in front of the cab, or some other conspicuous point; so that when the engines were in the house it would be difficult for a shopman to get in the cab and break into the tool box and steal the tools, without being seen by some one."

Mr. Mitchell then gave a list of tools which are kept in the box. It includes all the tools necessary for use in dealing with any ordinary break-down.

Some of the speakers who gave their views on this subject, considered that nothing more than a hammer and chisel was necessary on a locomotive, and they proposed keeping kits of tools in signal towers and at stations, which could be sent for and used when breakages happened. Others thought that the tools ought to be carried in the way car, but the majority favored keeping all the necessary tools on the engine. We side with the majority, and submit that any arrangement which leaves an engineer next to nothing to work with is likely to prove much more expensive than the cost of tools, even when that amounts to $2.50 a month. The proposal to keep the tools in signal towers and stations is simply absurd. Imagine a train stopped between stations or signal towers on a wild, stormy night because the engine had a broken valve stem. See the road blocked while a brakeman tramped several miles for the tools necessary to disconnect one side. The saving of a few dollars for keeping up tools would cut a remarkably small figure compared with the paralysis of the train service for an hour or two.

Taking all the tools off an engine to save the cost of maintenance is poor policy. A much better plan is something which puts responsibility upon individuals for the care of the tools. Every month adds to the complication of train mechanism, and every such addition increases the necessity for tools that can be used to rectify unexpected defects. The engineer is the mechanic of the train, and a mechanic cannot be expected to work without good tools, so the tendency ought to be to increase the tool equipment on the engine instead of to decrease it.

The Westinghouse Air Brake Co. have published a full report of the opinion recently rendered by Judge Morris in the United States Circuit Court, sustaining the Westinghouse quick-action brake patents in suit against the Boyden Power Brake Co. In a preface to the pamphlet, the Westinghouse Brake Co. mention that this is the fifth successive decision of the United States Courts, establishing the scope and affirming the validity of the Westinghouse quick-action air-brake patents. Brief comments are made regarding the other decisions. They say that more than 400,000 freight cars are equipped with the Westinghouse quick-action brakes, and that this type of brake has practically become the standard on nearly all of the principal railroads in this country. The value and the popularity being thus proved, the owners intimate that they will no longer permit railroad companies to purchase infringing brakes with impunity. Intimation is given that the Westinghouse Air Brake Co. will take a much more decided stand than it has hitherto done with railroad companies purchasing brakes which infringe their patents. This, we believe, is the first intimation given that railroad companies will be held strictly to account for infringement. Notice is given that the Westinghouse Co. will replace infringing devices upon extremely liberal terms; but those failing to have this done within reasonable time will be brought up with a short turn.

When hard times come on, it is the general practice of railroads to permit machinery, track and buildings to deteriorate for want of necessary repairs, and it is also very common to find the men responsible for this policy pretending that the property has been maintained in first-class condition. A notable exception to this is found in remarks made by President Perkins on the annual report of the C., B. & Q. Referring to the reduction of expenses shown in the report, he said that the repairs to rolling stock had not been kept up, and he estimated that $1,000,000 would be necessary to put rolling stock and buildings in first-class condition. This kind of talk is a little hard on stock speculators, but it is sensible business.

A committee has been appointed by President West, of the New York Railroad Club, to arrange to take the members and other people attending the conventions at Alexandria Bay by special train, leaving New York June 10, on the New York Central. The intention is to invite all railroad men and others, who will find this a convenient route in going to the convention. They expect that there will be a large party from the South, and from different points in the neighborhood of New York. The idea is to get as many people together as possible on their way to the convention, for the purpose of getting them acquainted during the journey. Other excursions of this kind have been highly popular, and we believe this one can be made a success.

The Goodyear Brothers, of Buffalo, N. Y., owners of the Buffalo & Susquehanna Railroad, have secured control of the Wellsville, Coudersport & Pine Creek Railroad, a standard gage line 12 miles long, which gives the B. & S. direct connection with the Erie.

EQUIPMENT NOTES.

The Fall Brook Coal Company are in the market for 200 cars.

The Louisville & Nashville are in the market for fifteen engines.

The Buffalo & Susquehanna have ordered two locomotives from Baldwins.

The Missouri, Kansas & Texas are in the market for fourteen locomotives.

The Boston & Albany are in the market for 200 box cars and 200 coal cars.

The C. & O. have contracted with the Ensign people to build 100 stock cars.

The Pennsylvania people are building 400 gondola cars in their shops at Altoona.

The Boston & Maine have ordered eight passenger engines from Manchester and six Forney engines from the Rhode Island Works.

The Rogers Locomotive Co. are building a couple of 14 x 20-inch switching engines, 48¼-inch gage, for the Cross Creek Coal Co., of Pennsylvania.

The Toledo & Ann Arbor are in the market for 500 freight and 25 furniture cars. This order was talked of last year, but was postponed, owing to depression in business.

The Mount Vernon Car Mfg. Co. have received an order from the Mexican Central for 100 box cars. This is the second order from that road within six months. The owners are reported to have been particularly well pleased with the work and material put upon the first lot of cars.

The Richmond Locomotive Works are building a heavy 10-wheel passenger engine for the Chesapeake & Ohio, which will be exhibited at the Atlanta Exposition. The Richmond compound illustrated in another page has been running on the Big Four for a month, and is now at Altoona undergoing scientific tests by the Pennsylvania Co.

The New York Railroad Club has adopted a resolution calling upon all the other railroad clubs to send representatives to a meeting at Alexandria Bay during the coming conventions, to arrange for taking charge of the entertainments at future conventions of the Master Car Builders' and Master Mechanics' Associations. The movement was heartily supported by the members of the New York Railroad Club, and we are led to believe that it is favored by all the members of the associations who have heard it explained. The existing method of levying contributions on supply houses to defray the expense of entertainment for the people attending the conventions is very unpopular with railroad men, and many protests have been made against it; but to take away the entertainments would have been to rob the conventions of a very attractive feature, and no better way was proposed for raising the required funds. The railroad clubs collect more money from advertising than what is necessary for current expenses, and they could easily provide all the money required for the convention entertainments. As the money for advertising in the club reports comes mostly from the firms which contribute to the entertainment fund, these would be relieved of a double burden which ought not to be placed upon them. By having the clubs manage the whole entertainment business, the members of the association would be relieved of an embarrassing position.

TRADE NOTICES.

The Craig-Reynolds Foundry Co., of Dayton, O., report increased sales of their very popular crossing gate.

The Lappan Brake Shoe Co. will be found in their new offices, Rooms 121 and 122, Taylor Building, 39–41 Cortlandt street, after May 1st, having moved from their old quarters, No. 18 Broadway.

We call attention to the advertisement of Theo. Hiertz & Son, of St. Louis, Mo., practical smelters of anti-friction metals, pig lead, tin and antimony, solder and composition metals particularly adapted to railroad and machine shop use.

The Hayden & Derby Mfg. Co., of New York, have published an illustrated pamphlet, giving practical information about injectors. Persons interested in using injectors will find a great deal of valuable information in this pamphlet.

The Ferracute Machine Co., of Bridgeton, N. J., have issued a new catalogue of their tools, principally presses and dies. The catalogue contains much information on the subject of die work. It is not standard size, and therefore will not be filed in many railroad offices.

The Fox tie plate is very fully described in an illustrated circular issued by the Avery Stamping Co., of Cleveland, O. This is said to be thoroughly up to date, and made to meet all modern requirements. The Avery steel fence posts are also manufactured by the same concern.

We have been shown orders for 428 sets of packing for locomotives and 28 for steamships, received within the past month by the Columbian Metallic Rod Packing Co., of Philadelphia. This shows a better feeling on the roads, as six months ago any of them would look twice before ordering a trial set.

The New York Safety Car Heating and Lighting Co. have published a graphic illustration of the progress made in the application of the Pintsch light on railroads of the world. From this we learn that twelve years ago the light had been applied to only 11,422 cars. To-day it is on 64,800 cars.

The U. S. Metal Polish Co., whose address is 295 East Washington street, Indianapolis, Ind., desire to send a generous sample of their metal polish to the man who "shines up" the bright parts of the locomotive and wants to make it look like a bran new dollar, without having that tired feeling afterwards.

The Union Grease Co., office address 39 Hartford street, Boston, Mass., have issued an interesting and instructive pamphlet on the subject of Lubrication, which they desire to place in the hands of every machinist, engineman and official. It illustrates how Union grease is made, and tells about experiments on various railroads.

The Schultz Belting Co., of St. Louis, Mo., have just issued the fifth edition of their valuable little book of information on selection and management of machine belting, with useful tables for determining the width of belt and horse-power. The book is full of new information, and is sent free to anybody interested in the subject.

The Standard Paint Co., No. 2 Liberty street, New York, are issuing, at a great expense, a handy book, size 9 x 12, containing samples of their principal "P. & B." products with prices and full descriptions. This valuable book should be in the hands of every purchasing agent, car builder, master mechanic and superintendent of motive power, or railroad man, interested in A1 roofing; and though the book costs $1.00, readers of LOCOMOTIVE ENGINEERING can secure a copy gratis, upon application.

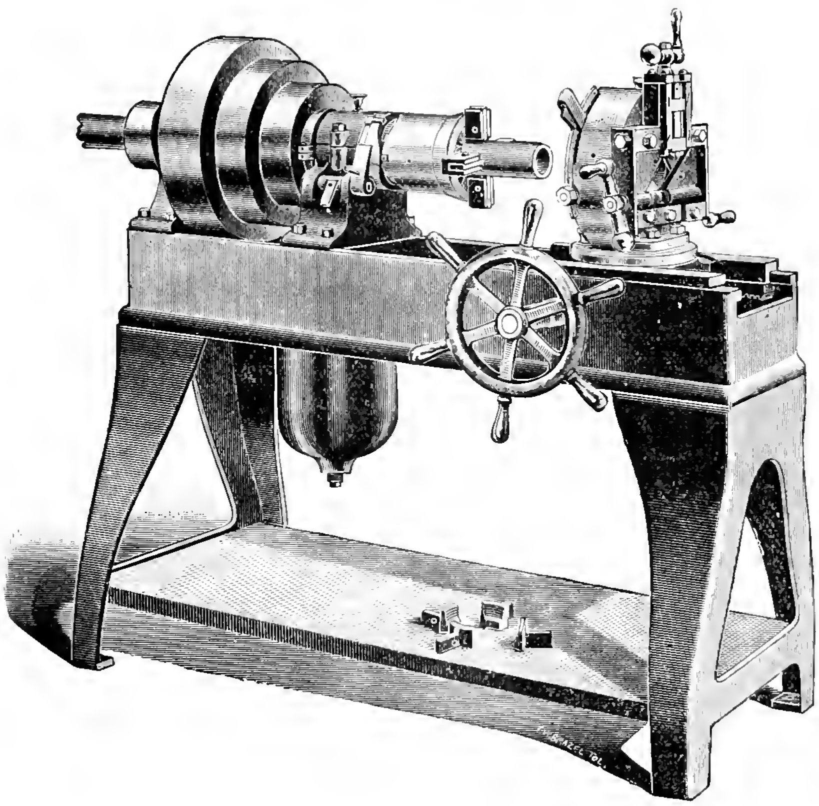
The Car Builder's Dictionary—1895 Edition.

This long looked-for book was published last month by the *Railroad Gazette*, New York. This is an illustrated vocabulary of terms which designate American railroad cars, their parts, attachments and details of construction. It contains 5,683 illustrations, and has been compiled for the M. C. B. Association by Professor John C. Wait, M. C. E., assisted by R. H. Soule, of the Norfolk & Western; A. E. Mitchell, of the Erie, and C. A. Smith, of the Union Tank Line. The work of compiling and editing has been admirably performed and the "Dictionary" appears to be as nearly perfect as human care and intelligence could make it. The book forms a library in itself of information concerning cars and their attachments. Nothing worthy of knowing about cars appears to have been left out. The scope of the work is so comprehensive and the details so numerous that we cannot go into particulars further than to say that it is the most useful book on railroad rolling stock ever published.

In one respect we must modify our praise of the book. The splendid illustrations are marred by being printed on inferior paper with poor ink, and the press work is unworthy of the high character of the book. The book is sold by the *Railroad Gazette*, New York. Price, $5.00.

Apex Nipple and Pipe Machine.

The annexed engraving represents a nipple and pipe mill machine, designed and built by the Merrell Manufacturing Company, of Toledo, O. This machine is designed and built with special reference to rapidity in the cutting and threading of pipe. The gearing is entirely protected from dust, being inside of the machine cone, thus giving six different speeds with but a three-set cone. The pump is out of the way of the operator, and can be changed so as to flood either the dies or the knife or shut off entirely, while the machine is in motion. The head is their standard adjustable, quick opening and closing dies, and is so swiveled that it can be reversed and the pipe cut off close to turned out duplicates of each other as to length, and length of thread. The chasers are five in number, and are set by graduation to any size desired; they are released from threading while the machine is in motion, opened to permit the pipe to pass through to the cutting-off knife, and closed instantly and positively. They can be sharpened by grinding, and are readily replaced by chasers cutting any style or pitch of thread. In operating, it is but necessary to insert the pipe, start up the machine, move the dog to close the vise, move the head to the pipe, and the machine will do the rest. This machine is made in two sizes, the No. 1 cutting from ¼ to 2-inch pipe, inclusive, and the No. 2 from 1 to 4-inch pipe, inclusive.



the grippers. The vise is opened and closed while the machine is in motion by the movement of a dog, either forward or backward. The sleeve operating the vise is adjustable, and can be adapted to the wear consequent upon long usage, and also to the variation in the size of pipe. By the use of the nipple grips, pipe of all sizes within the range of the machine can be threaded, thread to thread. The nipple grips can be closed on the threaded ends of the pipe without injury to the thread, thus avoiding the necessity of screwing the nipple into the grips after they are closed. This is a feature no other machine has. It will make left-hand threads as well as right.

The makers furnish with this machine a threading gage, which works automatically, and releases the chasers when the desired length of thread has been cut. With this arrangement, any number of nipples can be

The *Railway Age*, of Chicago, has published a very attractive pamphlet, giving valuable and useful information about the coming mechanical conventions at Alexandria Bay, N. Y. It has portraits of Mr. William Garstang, president of the Master Mechanics' Association, and of Mr. John S. Lentz, president of the Master Car Builders' Association. It has a map showing the position of Alexandria Bay and the principal railroads reaching there. People who expect to attend the convention will find this pamphlet a very useful reference. We believe the *Railway Age* people are prepared to send it free on application. The only objection to it is its bastard size; seems to us they should have used a "standard" for the Master Car Builders' Association — the mother of the standard size catalogue and paper agitation.

The Answers

TO THE

Traveling Engineer's Form of Examination

FOR

FIREMEN FOR PROMOTION

AND

ENGINEERS FOR EMPLOYMENT.

HUNDREDS have asked for the correct answers to the questions in this little book. At first the Traveling Engineers objected to publishing the answers, as it allowed men to learn the **answers** without understanding the subject. But the addition of the simple question **Why?** will show at once if the applicant knows what he is talking about.

Locomotive Engineering

WILL GIVE THE CORRECT ANSWERS IN THE

JUNE (1895) ISSUE.

This form of examination is standard on the D., S. S. & A. road, where the men pass 100 per cent. on them, and the answers will be furnished by Mr. M. M. Meehan, Traveling Engineer of that road, who was also chairman of the committee formulating the original questions.

See that you get that number of the paper.

WE will give 25 cts. each for the following copies of the LOCOMOTIVE ENGINEER:

Vol. 1, 1888, Nos. 1 to 7 inclusive;
" 3, 1890, No. 9;

and 50 cts. for the April, 1892, issue of LOCOMOTIVE ENGINEERING, also 25 cts. for the Index for 1892.

Write before sending. We don't want duplicates.

LOCOMOTIVE ENGINEERING, 256 B'way, N.Y.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(61) H. C. E., Moberly, Mo., writes:

Will you kindly publish recipe for a wash to take oxalic acid off brass? *A.*—We do not know of anything better than water for this purpose.

(62) L. C. B., Cumberland, Md., writes,

Asking for particulars of the rule for proportioning dry pipes of locomotive boilers. *A.*—There appears to be no established rule. On looking up the diameter of a great many dry pipes, we find that they vary from ¼ to ⅓ the diameter of the cylinder.

(63) D. M. T., St. Thomas, Ont., asks:

1. What are the principal causes for crank pins of eight-wheel engines breaking? *A.*—Side rods out of tram and poor material in the pins. 2. What is the best way to prevent this trouble? *A.*—Use first-class material and keep the rods in tram.

(64) W. H. Z., Packerton, Pa., asks:

Can a Westinghouse pump accumulate more air pressure in the main drum than the steam pressure that drives it? *A.*—Yes; when the air passage to drum is reduced at some point it often happens that the pump rams up a pressure greater than the steam pressure.

(65) J. D. H., Monterey, Mex., writes:

When tallow pipes, fed by ordinary sight lubricator, are placed in a horizontal position on the running board, I think when an engine is ascending a heavy grade that the valves would not get sufficient oil. What do you think? *A.*—We believe your opinion is correct.

(66) E. G. C., Washington Depot, Conn., writes:

Will you kindly tell a subscriber if there is any make of steam engine that does not receive steam at the two ends of the cylinder alternately? *A.*—Yes, there are many engines that are single-acting. The Westinghouse and the Brotherhood are the best known of these types.

(67) Dr. V., Detroit, Mich., asks:

1. What is the ordinary length of firebox on eight-wheel and mogul engines burning soft coal? *A.*—About 6 feet for eight-wheelers and about 7 feet for moguls. 2. What is the longest firebox for soft coal burning you have heard of? *A.*—Ten feet. 3. What is the longest firebox for hard coal you know of? *A.*—Eleven feet.

(68) W. M., Trinidad, Colo., writes:

What causes an engine to run ahead when hooked up to the center? I claim that it is because the reach rod is too long. Am I right? *A.*—No; you are wrong. When running light, most locomotives will run with the reverse lever in the center notch. The lead opening of the valve admits steam sufficient to enable the engine to do light work.

(69) W. A. R., Cedar Rapids, Ia., says:

What is the inside flange on a driving box for? Is it necessary? *A.*—Of course, it is supposed to be one side of a guide for holding the box in the frame pedestals. It is also a simple way of making the box strong. We do not think it necessary. If the inside flange was left off, the bearing could be made longer and the box strengthened by having a greater width.

(70) F. E. L., Chicago, Ill., says:

1. We have had a dispute about direct and indirect engines, and I have been appointed a committee of one to ask you to settle it. *A.*—A direct engine makes direct connection between the link block and the valve stem. An indirect engine has the link block connected to a rocker arm. 2. Are the Baldwin compounds on the South Side Rapid Transit Railroad of Chicago, direct or indirect engines? *A.*—Direct.

(71) H. B., Cleveland, O., writes:

1. How does Mr. Rupert, Ionia, Mich., in his kink for planing out fluted rods, feed his tool down on the planer? *A.*—It is fed down in the same way as any other planer tool, carrying the lifting rollers with it. 2. Will you give us a description and illustration of the Whitworth tool, which you stated was so extensively used in England? *A.*—No. The tool is patented, and has been repeatedly illustrated in American publications.

(72) R. B. C., Los Angeles, Cal., writes:

I have been advised to subscribe for stock in an inter-oceanic electric railway company, which promises to revolutionize our system of transportation and make millions for those who get in on time. What do you think about this as an investment? *A.*—We think it is a good thing to keep out of. There are too many inter-oceanic railways already for the business to be done. If there were any advantage in using electricity as a motive power, the existing railroads would soon adopt it.

(73) E. P. B., Birmingham, Ala., writes:

What is the nature of the reinforcing brake that was experimented with last year by the New York Air Brake Co.? *A.*—It is an arrangement by which a supplementary brake cylinder increases the pull on the brake lever when a very quick stop is required. The air from the train pipe is admitted to this cylinder when the pressure in the ordinary brake cylinder becomes greater than the train-pipe pressure. The supplementary brake cylinder is put out of action by letting all the air out of the train pipe.

(74) P. T. S., Wheaton, Minn., asks:

1. Is it possible to change the lap of a valve by changing the eccentrics? *A.*—No. 2. I have heard about locomotives running with reverse lever in the center notch. How can they be made to run in the direction wanted? *A.*—When an engine is going it will keep on when the reverse lever is pulled to the center if the load is light. If you try to start an engine with the reverse lever in the center, the chances are that it will not go; but if it does move, its direction will depend upon the position of the crank when steam entered the cylinder.

(75) P. S., Danville, Ill., writes:

1. What are the duties usually assigned to a mechanical engineer by a railroad company? *A.*—He is required to design all rolling stock and other machinery built by or for the company, he acts generally as office assistant to the head of the mechanical department, conducts all investigations into mechanical matters, and is expected to furnish information on every engineering question that arises. He is supposed to know more than any other man in railroad service. 2. Are relief valves on steam chests of any proved benefit? *A.*—This is an unsettled question; generally believed they are.

(76) G. S. H., Windsor, Ont., asks:

Is electricity, as applied through the trolley, likely to supersede steam as the motive power on railways? Apart from the fact that an accident in the power house would temporarily paralyze the entire line, is the cost of the production of electricity within competing distance of steam, as applied through the locomotive

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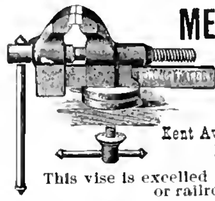

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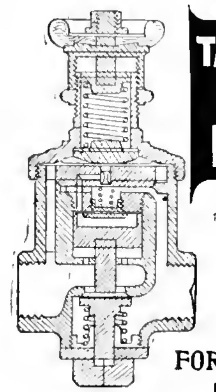

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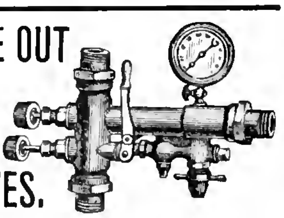

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to the haulage of passengers and freight over long distances? *A.*—At present, electricity does not appear to be on a competing basis with steam locomotives for ordinary traction. There are, however, inventions partly developed which may give electricity the advantage.

(77) B. R. L., Raleigh, N. C., writes:

At the request of friends, I write to ask you to give a rule for finding the position of saddle pin on link. *A.*—There is no rule for this. When a mechanical engineer is scheming the valve motion for a locomotive, he finds by measurement on the drawing board the proper location of the stud. When an engine is rebuilt, and the proportions of the valve motion changed, it is customary to find by experiment where the stud should be located to produce an even cut-off. The method of locating the saddle stud is described in Sinclair's "Locomotive Engine-Running," and in "Auchincloss on Link Motion."

(78) J. H. P., Allensville, Pa., writes:

1. Which do you think the best way of examining a boiler—to test it with a high pressure, or have the staybolts, etc., examined by an expert? *A.*—Both should be done, but we prefer the expert if we can't have both. 2. Some engineers advise mixing wheat bran in water and pumping it in the boiler (when under high pressure) to stop a small leak. Do you think it a good plan? *A.*—It will do as an emergency remedy to keep flues and seams or cracks from leaking. 3. Do you think it harder for an engine to run over or under, as mentioned in your last issue? *A.*—We do not think there is any difference.

(79) G. H. G., St. Paul, Minn., asks:

1. Name of rod that goes through hollow reel that holds radial bar on pony trucks of Rogers mogul. *A.*—By "hollow reel" you probably mean what is called the "center pin," which is a cylindrical casting, whose lower end rests in the swing bolster or cradle. The rod running vertically through it is called the "center-pin bolt," and is attached at its lower end to the longitudinal equalizer that distributes the weight of the front end of the engine between truck and front drivers. The "radius bar" is bolted rigidly at its front end to the truck frame, and at its back end is pivoted by the "radius-bar pin" to a cross brace between engine frames.

(80) A. B. P., Galion, O., asks:

1. Is there any difference between direct application of the air brake and emergency? *A.*—Correctly speaking, there is no manipulation of the air brake known as direct application; letting air out of the train pipe by other means than the service position of the engineer's valve might be termed direct application; in nineteen times out of twenty it would result in an emergency action. 2. Where should the engineer's valve be placed in testing train? *A.*—Make a heavy reduction, enough to set brakes well, then place valve on lap. This is a good way, but on some roads they require the exhausting of all the air in the train line while examination is made. You should have Conger's Air-Brake Book.

(81) G. W. C., Erie, Pa., writes:

1. Will you please give me particulars of the mixture used for etching iron and steel to show the structure of the metal? *A.*—There are several mixtures used. Equal parts of nitric and hydrochloric acid makes a strong mixture. One part of nitric acid mixed with 100 parts of distilled water is used by some, while others double the quantity of water. The latter is the best mixture to use when a print of the piece is wanted. 2. How is the work of etching done? *A.*—Polish the article well and have the surface as nearly flat as possible. Wash it with alcohol to remove grease. Apply the acid. When the surface becomes black, wash the surface in a stream of water and a brush, then apply the acid again and repeat the washing. When the polish disappears and the surface becomes a grayish color, wash thoroughly and dry quickly on a heated surface.

(82) F. O., Brooklyn, N. Y., asks:

1. What is the object of the relief valve on the cylinders, and why are two placed on compounds? *A.*—Relief valves prevent dirt and cinders from being drawn down the nozzles and into cylinders; the low-pressure cylinder of the compound requires it the same as any other cylinder. 2. Why is it that the relief valve keeps clicking when running without steam? *A.*—Because the air is drawn into chest in pulsation. 3. Is not the placing of crank pins at right angles a detriment to compounds on account of back pressure in smaller cylinder? *A.*—We do not see what difference the angles of the crank can make to the back pressure. 4. What rules govern the proportions of one cylinder with regard to the other? *A.* There is no exact rule, but the low-pressure cylinder of locomotives is generally made from two to three times the size of the high-pressure cylinder.

(83) E. B., Gainesville, Tex., writes:

1. If an eccentric has a throw of 6 inches, why does this not cause the valve to travel 12 inches? *A.*—The throw of the eccentric is usually understood to be the amount of its reciprocatory motion; in that case, the throw being 6 inches, causes the valve to travel the same distance, if the rocker arms are of equal length. Some people call the amount of eccentricity the throw of the eccentric; in this case, an eccentric having 6 inches of reciprocatory motion, would have 3 inches throw. 2. What causes the reverse lever to go in the same direction as the motion of engine? *A.*—The weight of the links and their connections are hanging on the reverse lever. This weight is usually supported by counterbalance spring, but the spring is rarely sufficient to keep the reverse lever from dropping forward when it is taken out of the latch. The friction of the eccentrics has a powerful influence in pressing the links down or up—according to the direction the engine is going—when going forward, of course the action is downwards, and when backward, the action is upwards. This is particularly apparent when the eccentrics are running dry.

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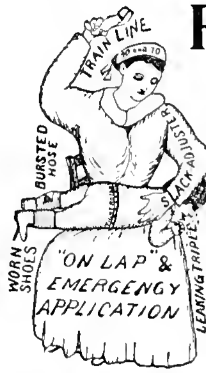

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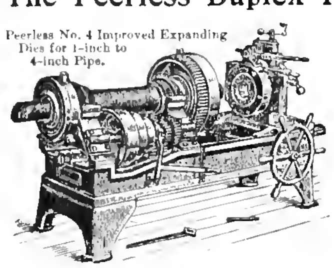

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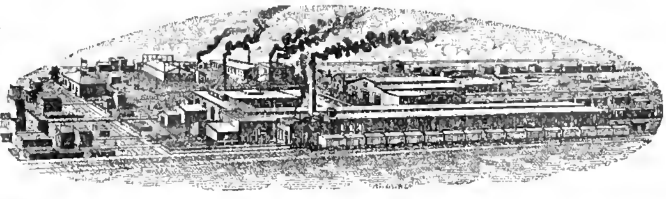

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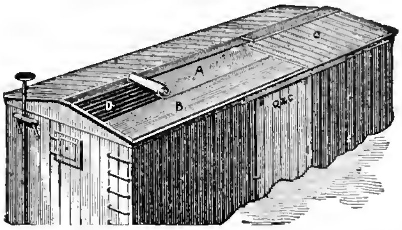

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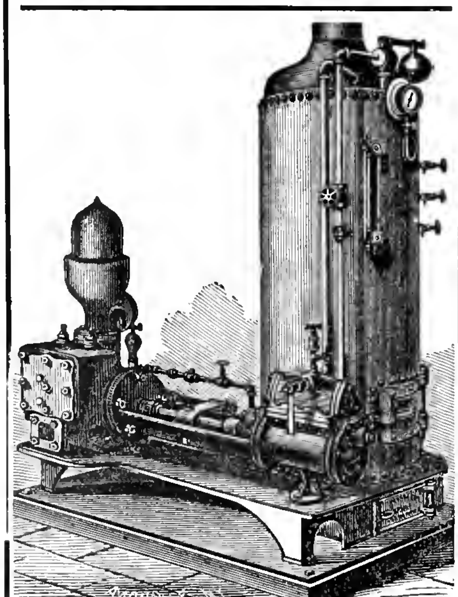

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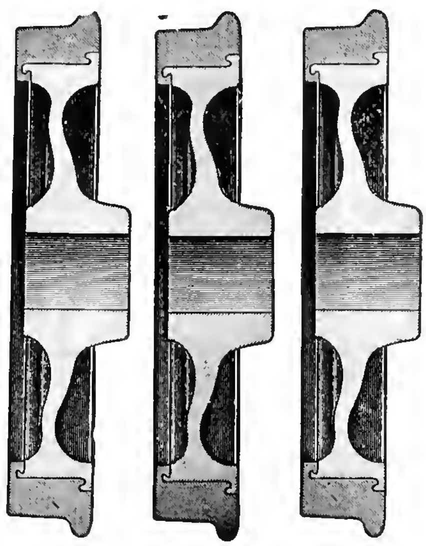

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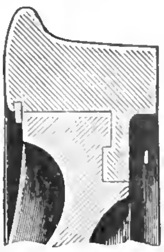

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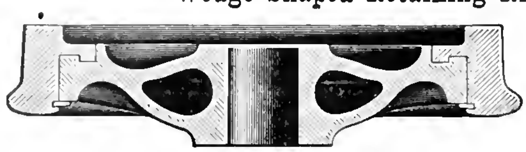

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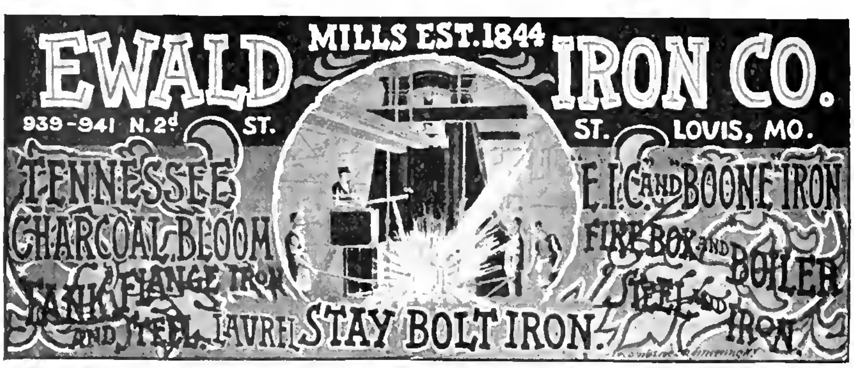

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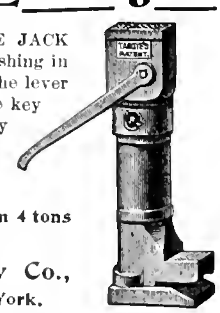

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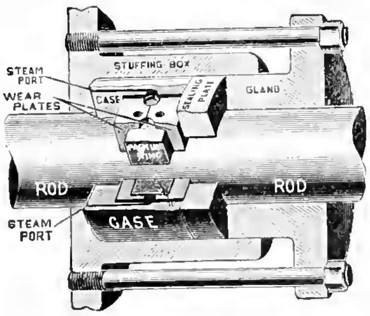

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NO SPRINGS. OLD GLAND USED.

Friction Next to Nothing. Protracts Life of Rods.
Three Rings for Heavy Service.
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Will Contract to provide this Packing for Half Cost of using Flexible Packing.

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ESTABLISHED 1828.

BOSTON BELTING CO. EXCELSIOR TRADE MARK AIR BRAKE EST. 1828.

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AIR BRAKE AND CAR HEATING HOSE.

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OUR EXCELSIOR AIR BRAKE HOSE GUARANTEED FOR 2 YEARS.

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380 East Water Street, MILWAUKEE, Wis.
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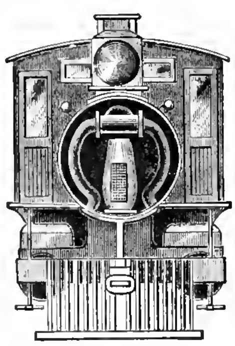
The Smith Triple Expansion Exhaust Pipe.

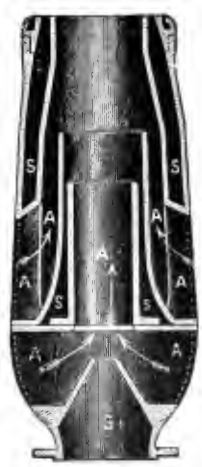
FRONT VIEW.

THIS DEVICE is the invention of JOHN Y. SMITH, the originator of the Smith Vacuum Brake. In the cuts of the Front and Side Views shown herewith, "AA" represent Air Passages; "SS" Exhaust Steam Passages, and "B" an Annular Blower forming part of the Nozzle.



It is an entirely new departure in the construction of Exhaust Pipes for Locomotives. Its distinguishing features are that the exhaust steam is not restricted after it leaves the cylinders, and the gases and heated air in the smoke arch are mingled with the exhaust steam in the exhaust pipe. The exhaust steam is thus superheated and expanded and a powerful, prolonged, pulsating blast is created, which keeps the fuel in a constant state of agitation, and produces more perfect combustion.

Some of the beneficial results obtained are: *Reduction of Back Pressure to a minimum (area of nozzle opening as large as the exhaust port); prevention of ejection of sparks from smoke stack; almost complete absence of noise from exhaust; prevention of formation of clinkers in firebox; large saving of fuel.*



SIDE VIEW.

By the elimination of Back Pressure we have demonstrated the fact that the power of engines has been increased to be able to pull from thirty to sixty tons more than with any other form of exhaust pipe.

The pipe can be used with either straight or diamond stacks, in long or short front ends, and on locomotives burning hard or soft coal, wood or coke.

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EXPANSION BOLTS.

FOR FASTENING ALL KINDS OF STRUCTURE TO BRICK AND STONE WORK.

Patentee and Mfr., **ISAAC CHURCH,**
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General or local Ladies or gents. **Agents. $75** a week Exclusive territory. The **Rapid Dish Washer.** Washes all the dishes for a family in one minute. Washes, rinses and dries them without wetting the hands. You push the button, the machine does the rest. Bright, polished dishes, and cheerful wives. No scalded fingers, no soiled hands or clothing. No broken dishes, no muss. Cheap, durable, warranted. Circulars free.

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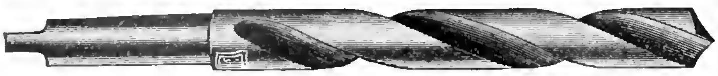

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Pope Light Compressed Oil Gas:

Interchangeable with "Pintsch;" and superior thereto. Uses same gas as "Pintsch" In Great Britain 14,262 steam and cable cars already equipped. Patents guaranteed.

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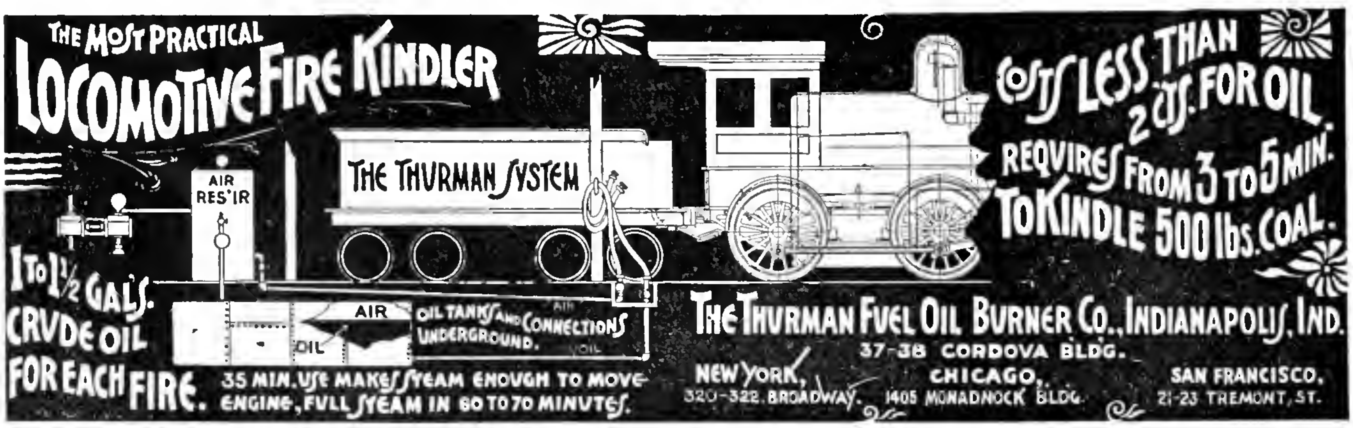

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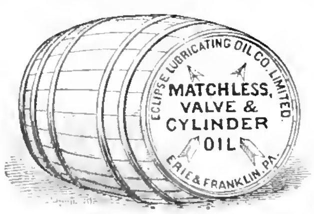

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Hammered Charcoal Iron is the **Only Kind**

used by The Tyler Tube and Pipe Co. in their Boiler Tubes. Washington, Penn. New York Office: 39 Cortlandt Street.

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THIS is the only single tube "Automatic, or Re-starting," Injector that will start with 25 lbs. of steam and work up to 200 without trouble.

IT is a plain, heavy business machine,—no small priming jets, pipes or valves.

ONLY 24 pieces—less than half the usual number of parts.

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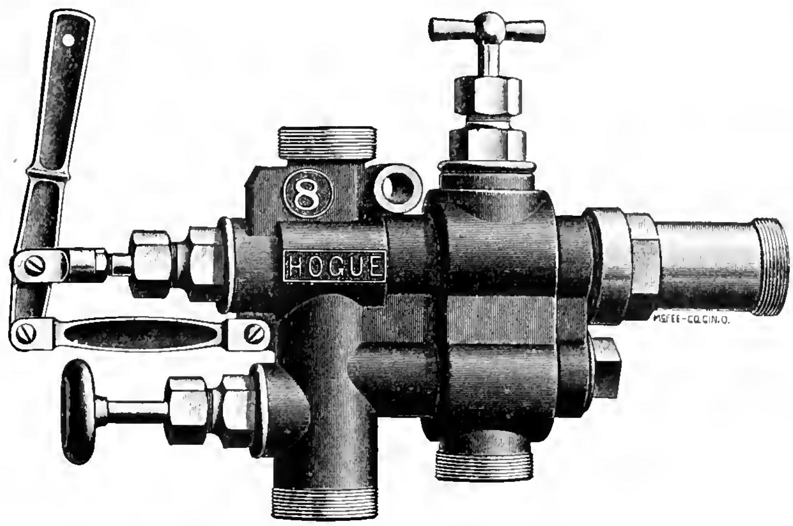
SIMPLER, lighter and the cheapest guaranteed Injector on the market.



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CUT down your road failures and repair bills by using a solid instrument with no jimcracks to it.

LESS parts means less repairs, less first cost and less trouble.

STOPS and starts with one movement of lever, restarts if broken,—you know that instrument is feeding if lever is back.

GUARANTEED! We will place this instrument on any boiler for trial, and if not entirely satisfactory will remove same free of all expense. Let us show you what we can do.

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40 to 1 Is big odds, isn't it?

It's a fact, though, that a well-known Master Mechanic and Superintendent of a R. R. in Pennsylvania reported in writing to the storekeeper, that a trial lot of ***P. P. P. Diagonal Rod Packing,*** put to a severe test on their division, outlasted what they had been using **"40 to 1."**

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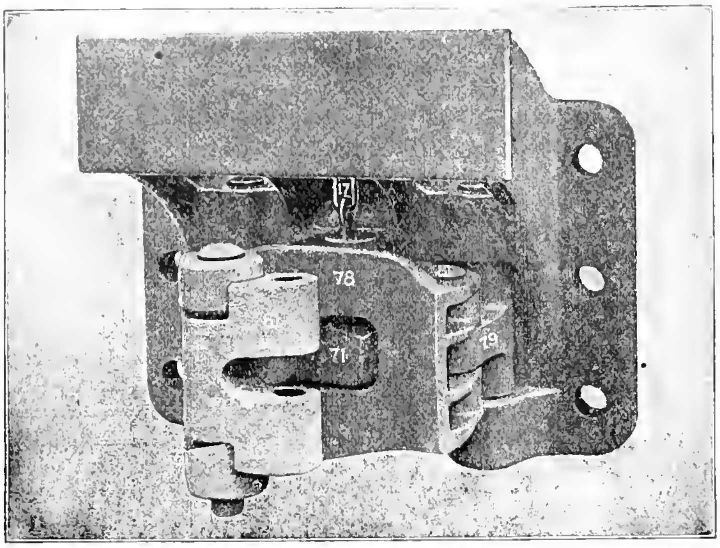

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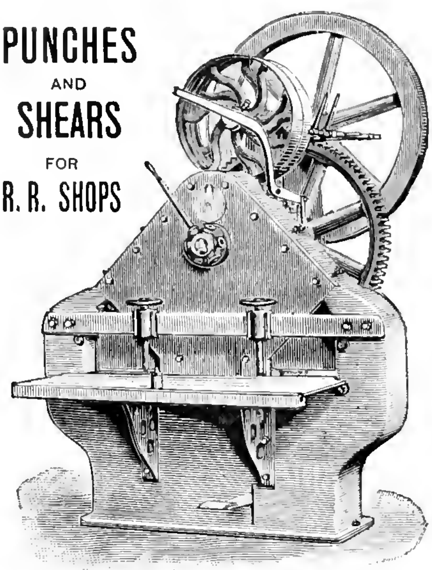

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A CENTRAL DRAFT AUTOMATIC COUPLER with Positive Self-Opening Knuckle without the Use of Weight, Spring or Lever, will open on any grade up to 1200 feet to the mile.

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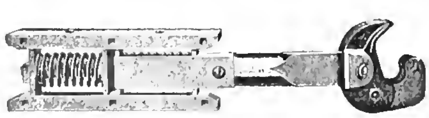
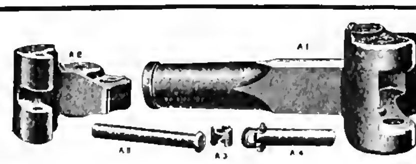


MINER DRAW BAR ATTACHMENT.



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THIS ATTACHMENT HAS BEEN IN SERVICE FOR THREE YEARS WITHOUT A SINGLE BREAKAGE.

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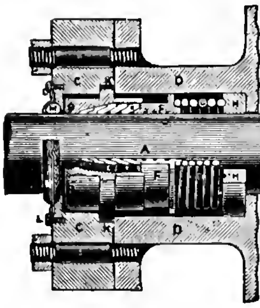

This is the Standard Metallic Packing all over the world, and is more generally adopted and in use on more locomotives than any metallic packing in use. Give the **JEROME** a trial and be convinced. Put it in competition with any other packing and be convinced of its superior merits.

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Packing ring opened ready to apply without disconnecting the Piston from the crosshead. It runs longer and wears the rod less than any other packing in use.

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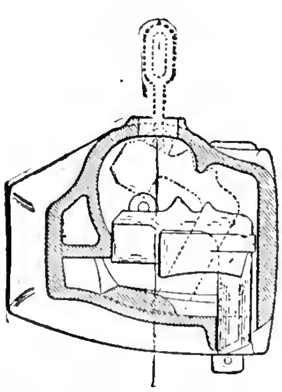

Sectional view back of lock looking forward. Dotted lines show the lock lifted full height for uncoupling and opening knuckle, and ready to couple again.

THE TOWER COUPLER.

Any competent mechanical engineer who examines with care the construction of this coupler, finds that all the requirements of service have been met in most ingenious but simple ways. It compares with other automatic couplers, as a high-grade Columbia or Victor bicycle compares with a child's velocipede.

It couples easily, smoothly and surely when the cars are brought together. Under no circumstances are repeated attempts to couple necessary. Delays to trains and shocks to passengers and freight from this cause are entirely avoided.

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The bar is of malleable iron of uniform best quality, and so placed as to give the greatest possible strength. Knuckle lock and pin are of steel.

In uncoupling, the lock itself throws the knuckle open, no separate piece of any kind being required. The action of the lock, both in coupling and uncoupling, is quick, positive, and sure, under all conditions.

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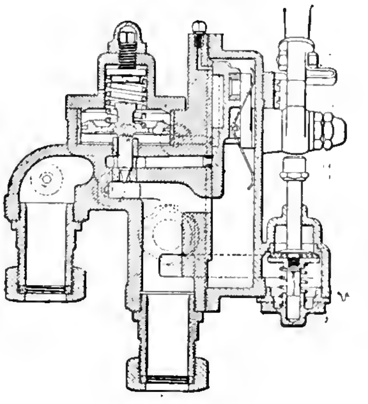

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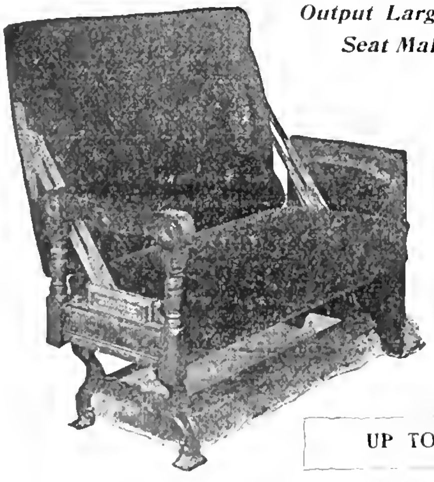

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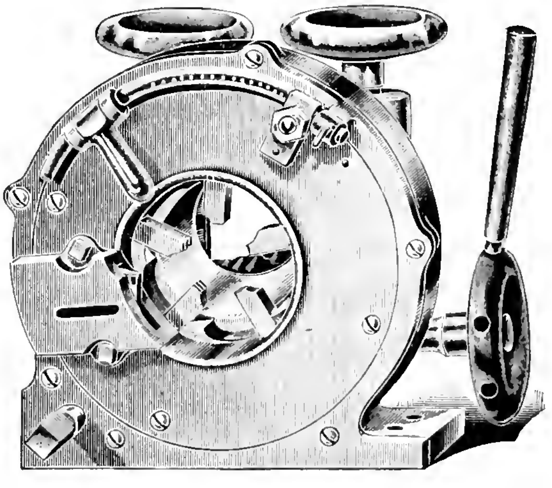

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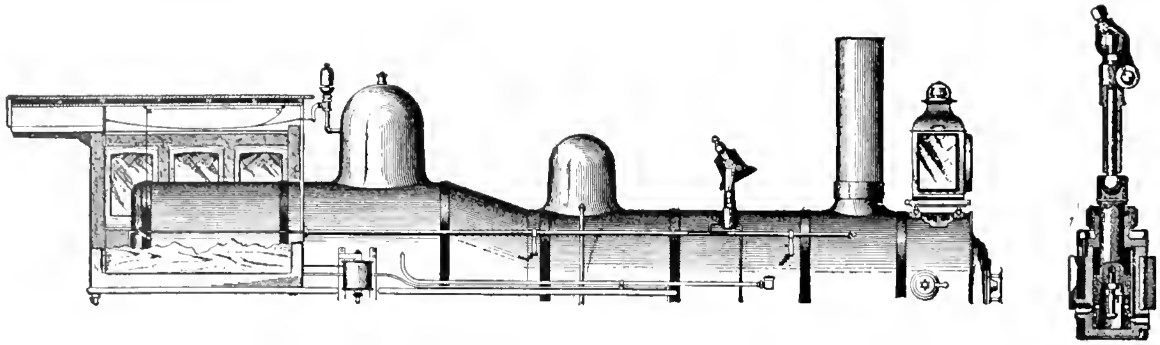

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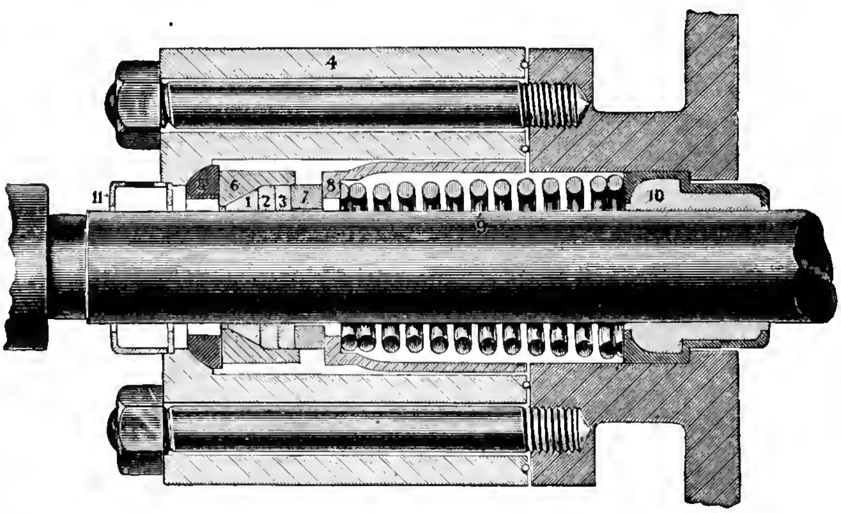

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Will go in place of old glass tube. With 350 degrees of heat on inside a stream of ice water will not break it. One glass is a permanent part of the locomotive.

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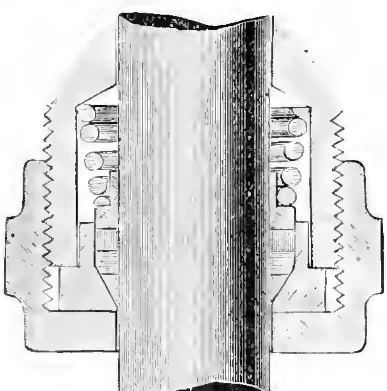
A trial will convince anyone of its merits.



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Giving A1 satisfaction on several roads. Saves time, labor and rods. Worthy of a trial. Try it.

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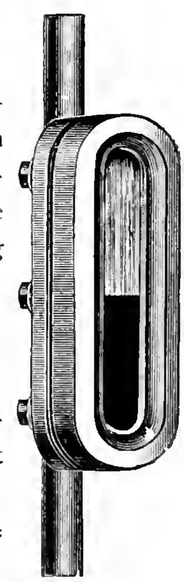

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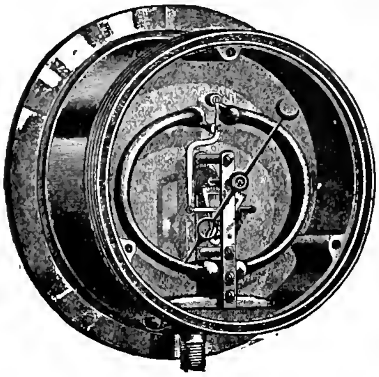
Double Bourdon Spring and Elastic Packing Ring.

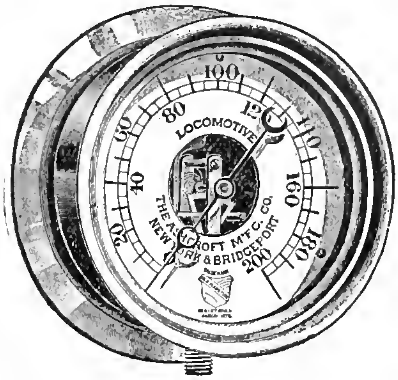
SPECIAL SEAMLESS DRAWN TUBING.



Only Gauge where Movement Frame and Spring are removed from contact with back of case.

ELASTIC PACKING MAKES CASE AIR TIGHT.

No Dust or Moisture Enters.



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THE MUFFLER IS A SIMPLE ATTACHMENT TO RICHARDSON'S WELL-KNOWN ENCASED

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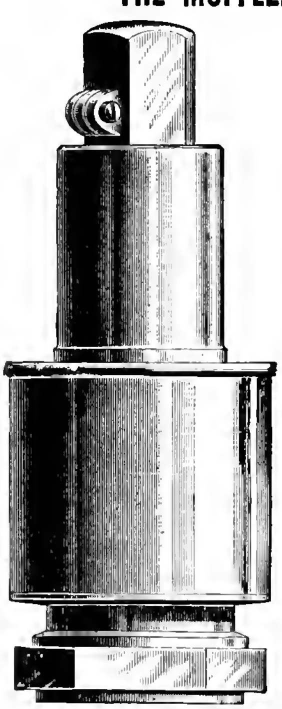

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IS FITTED WITH THIS VALVE AND MUFFLER, AND THE VALVE AND MUFFLER HAVE BEEN ADOPTED AS STANDARDS BY THE ROAD.

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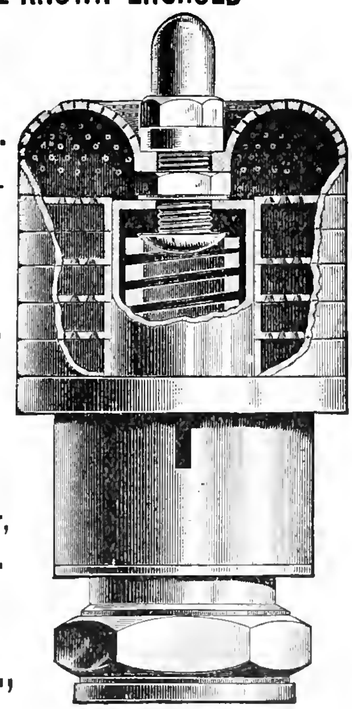

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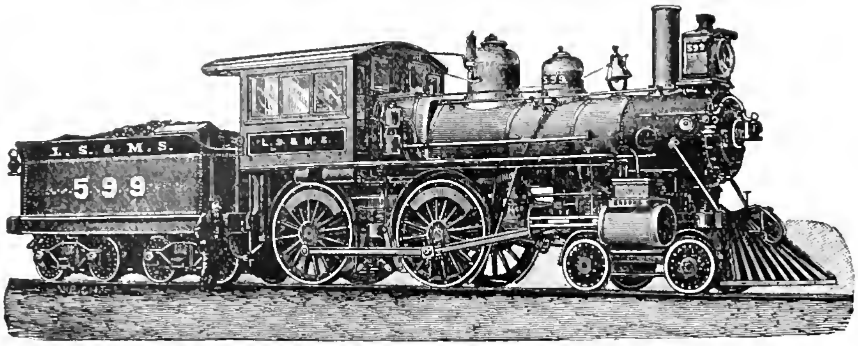

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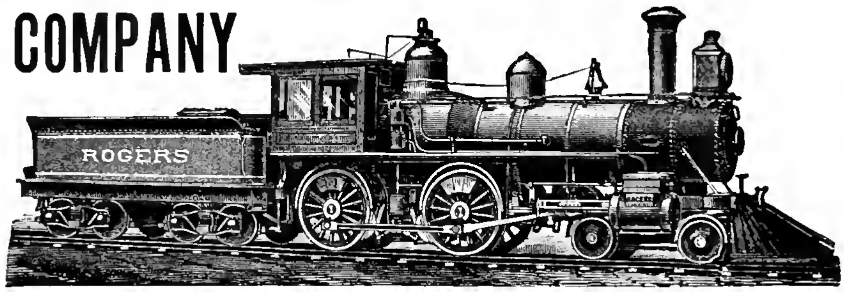

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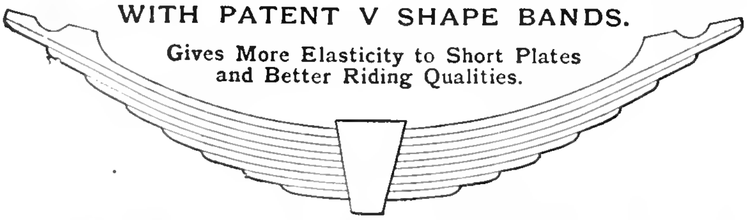

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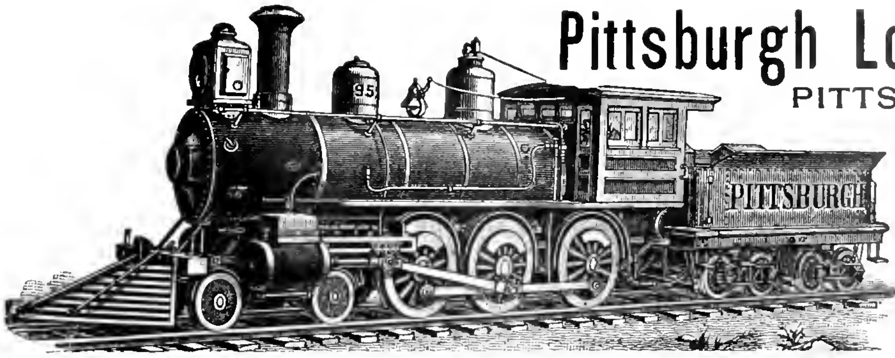

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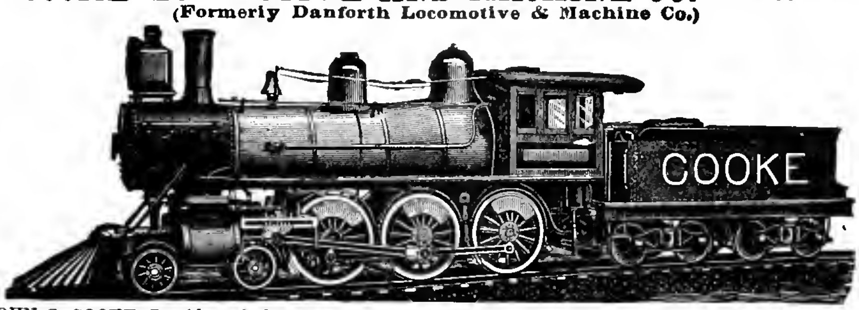

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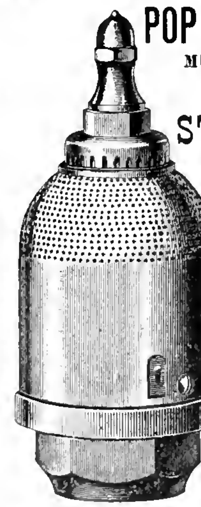

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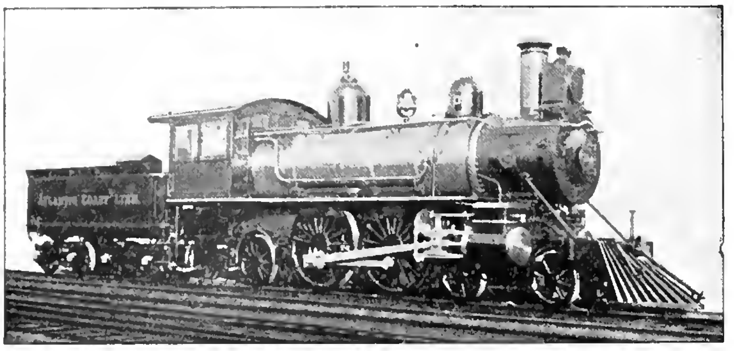

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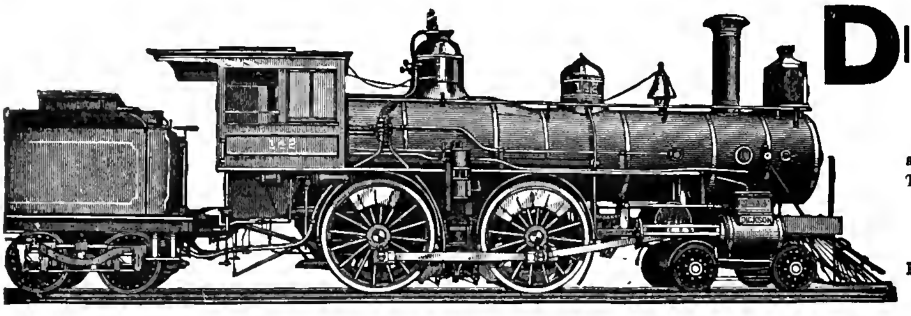

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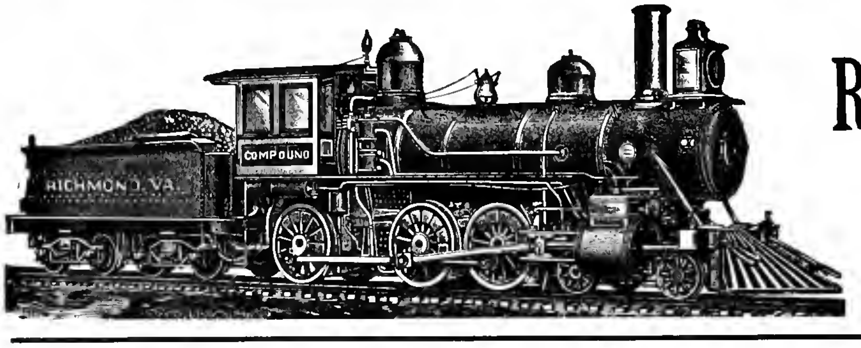

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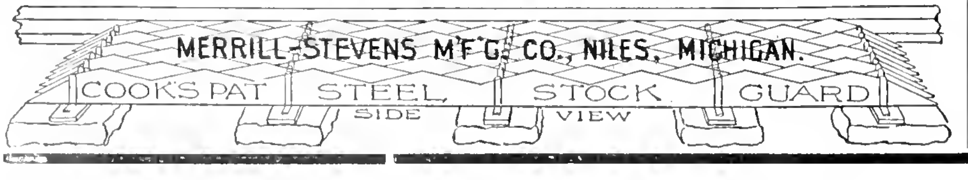

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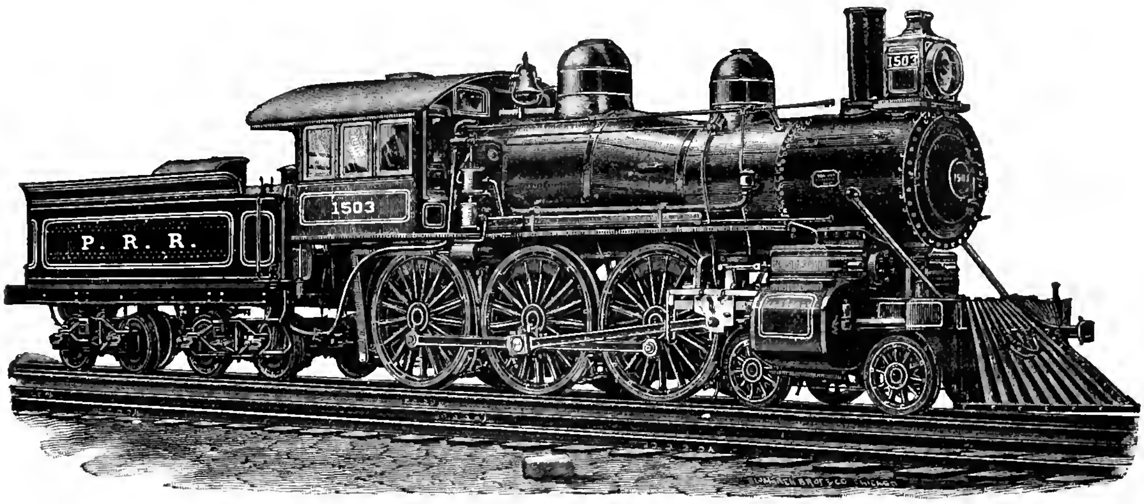

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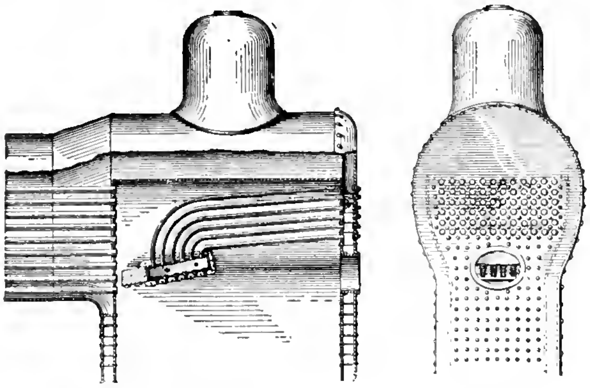

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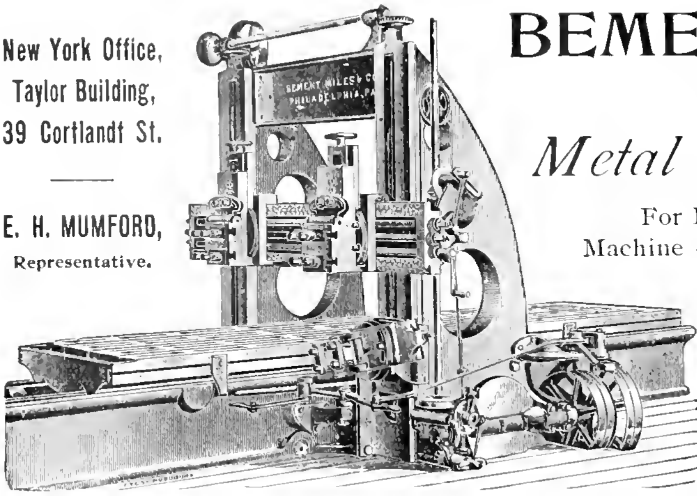

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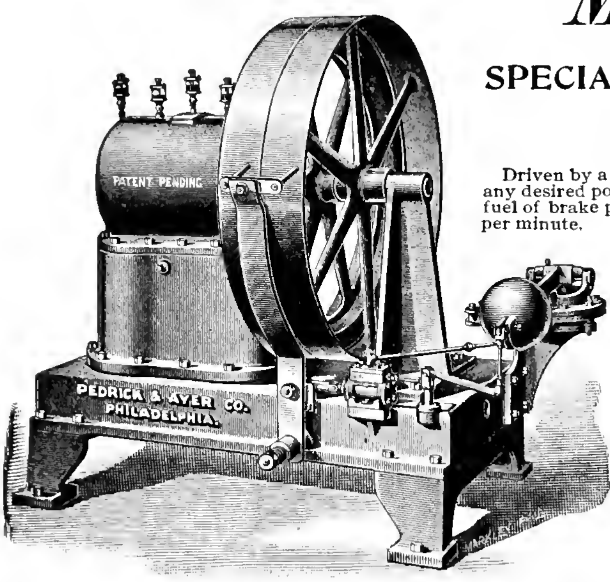

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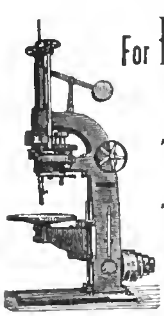

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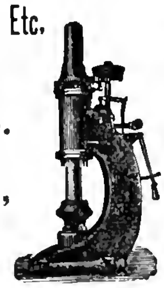

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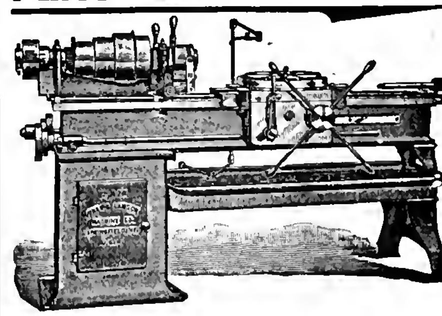

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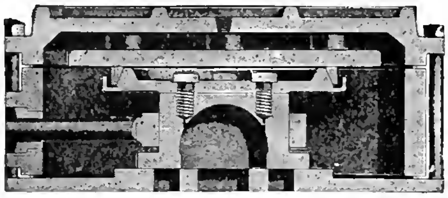

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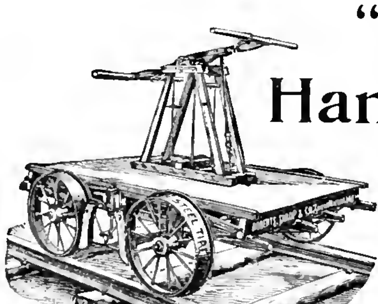

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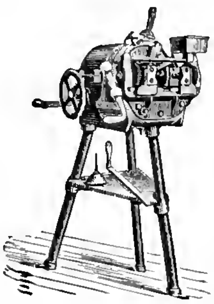

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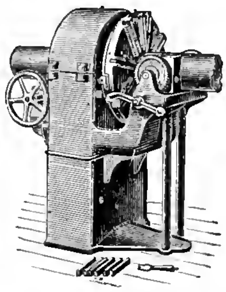

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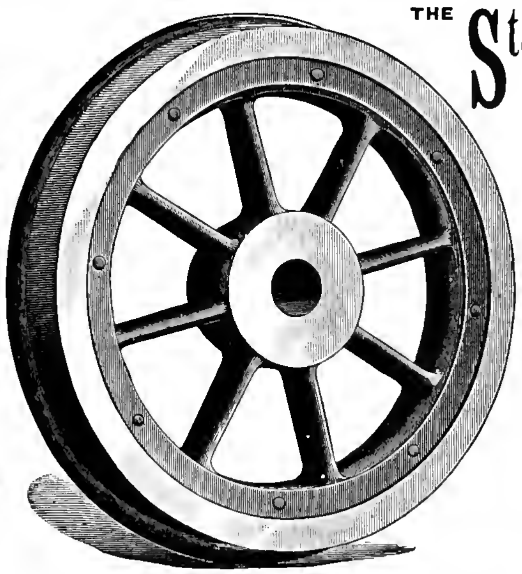

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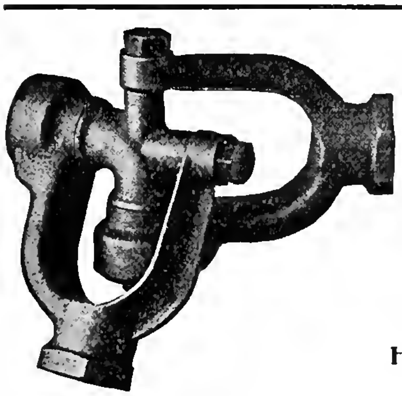

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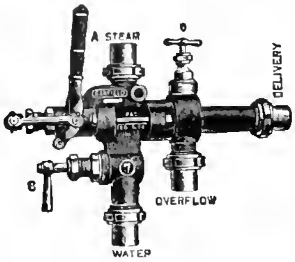

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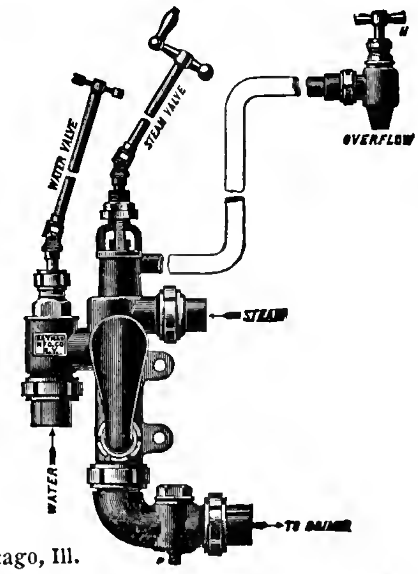

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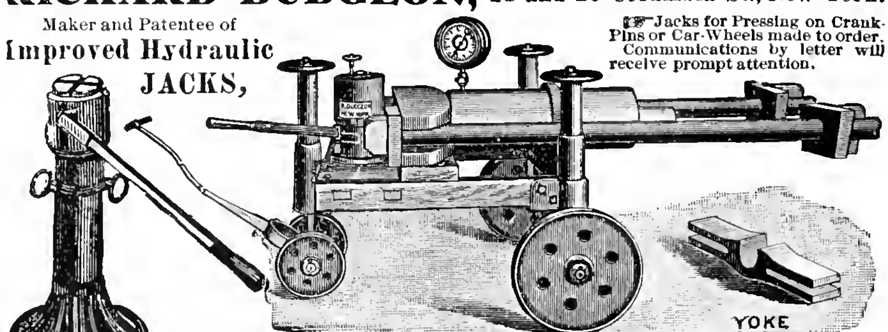

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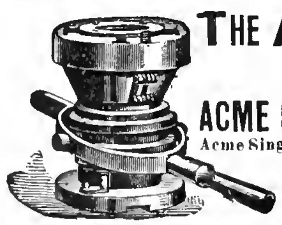

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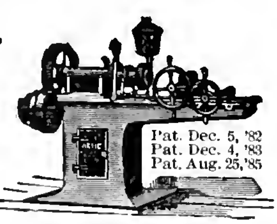

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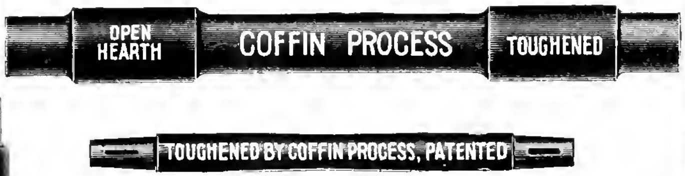

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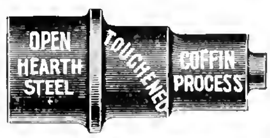
Piston and Side Rods, 

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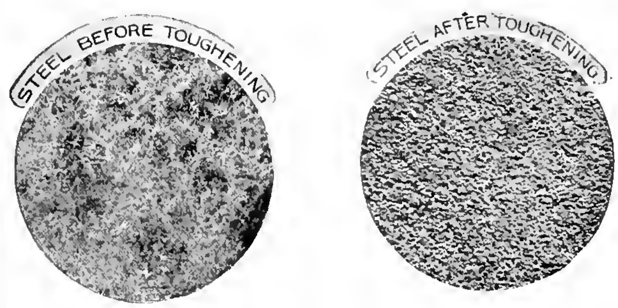

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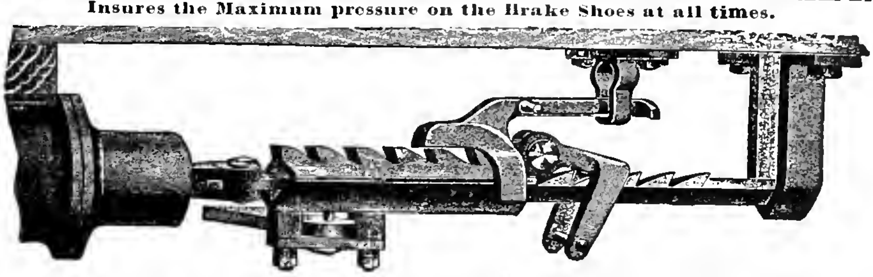

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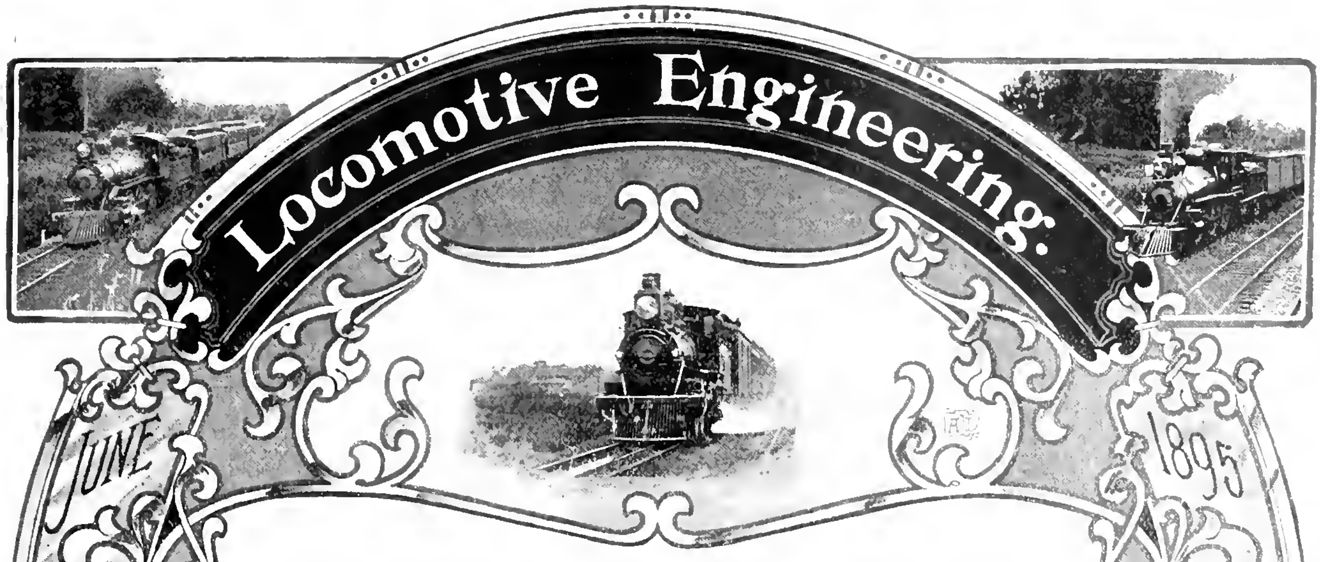


A Practical Journal of Railway Motive Power and Rolling Stock.

256 BROADWAY, NEW YORK.

[*Trade-Mark Registered.*]

Volume VIII. Number 6.

Jim Skeevers' Object Lessons.

A Few Everyday Incidents of Shop Management—Skeevers Has a Collision.

When the "old man" went East last month, he left a two-line bulletin notice that James Skeevers would act as general master mechanic during the absence of John Massey, assigned to other duties, and be obeyed accordingly. This was very discouraging to the signers of the famous petition. Skeevers forgot all about the petition and was the only man about the place that did not worry about it.

Having a whole month of his own way he looked around to see if he could improve something, but there was so much needing improvement that he hesitated where to begin. While he was thinking, one of his petition-signing machinists came in with a broken gear in his hand.

"Mr. Skeevers, I've got that Pedrick cylinder borer all set in the '119's' left cylinder; but I find this gear broke—what'll I do with it?"

"How did you break it?"

"I didn't break it."

"Who did?"

"I dunno."

"Did you use the bar last?"

"No, sir; it wan't my turn."

"How's that? I saw that bar under your bench."

"That's where they usually keeps it; but Johnson used it last. You know, sir, us floor men take turns here, so's to even up the work; there's nine of us, and we take our turn boring cylinders, facing valves, putting in steam pipes, and the like of that."

"Well, you leave the bar where it is; I'll telegraph Stebbins for the use of his gear while we get a new one. By the way, Oscar, who takes care of the tools and wrenches and the parts of the boring bar?"

"Nobody, sir; each of us fixes it up when we use it; and when we git done, chuck the whole business under the bench."

"Who takes care of the plugs and gages, etc., that you use in grinding in and setting steam pipes?"

"We all has plugs, or else borrows from one another."

"All right, that will do," said Skeevers.

Oscar got to the door, when Skeevers stopped him.

"By the way, Oscar, about how long does it take you to get ready and bore a cylinder?"

"Well, sir, it spoils the best part of a half day for myself and helper to set the bar, rig up the rope drive and flexible shaft, and get the tools ground and ready, and then, well, say five hours for the cut. It's a job a man can't hurry, sir."

"Yes, that's so; well, I'll send for a gear—do something else till it comes."

Skeevers telegraphed for the gear; then he took a scratch pad and figured up Oscar's time and that of his helper for the time of boring out one cylinder.

Skeevers has a great habit when alone of making a few hasty figures on a scratch pad, then pacing up and down the room "thinking" out loud. If we could only get a phonograph in that den of his we might give our readers some valuable "thinks." His time-keeper, however, overheard the following soliloquy:

"I'll put one man on that job—that's the stuff. One man can fix up his tools and will keep the bar in good order—I dunno, maybe he'd spend more time tinkering with it than in working, same as that dog-goned carpenter up at the house; files his saw twice a day, wears the darn saw out that way—ah! I've got it; I'll put that job on piece work—that's the stuff. There's enough for one man—no, there ain't! Yes there is, too, if I give him the valve facer too; he can make better pay than day's work and save the company money besides. Le'me see, that measly tangle of rope and that stinkin' old snake wobble of a flexible shaft takes more time than the boring bar. Flexible shaft!—the very name of one is enough to make me swear—they ain't no good excepting for drilling or something like that—they are behind the age, better'n nothin', better'n a ratchet drill (and not so darn much, either), but they ain't in it with air—that's the stuff. If I only had air on that job I'd skin things—got the air but no engine, and I ain't got time to make one. That wim-wam wobbler is new, too; jest like Massey, to go buy *that* when air is the thing. By George, I've got it!"

Skeevers jumped to the telephone, rang the bell and took down the ear-piece. Of course the telephone whispered, and the time-keeper couldn't note what it said, but this is what Skeevers said:

"Hello, hello! Say, give me 1327."

"Yes, yes; Davis' machine shop."

"Hey?"

"Never you mind, Maggie, I'll do the talking and ——"

"Yes, this is the Great Air Line shops. Is this Davis?"

"Well?"

"No, I want to talk to Mr. Davis himself."

"This you, Davis? Well, say, how's the shafting lathe?"

"Yes, good trade, eh? Well, say, how much are them little upright engines of yours worth—hey?"

"Hundred and ten? Oh, say, Davis, come off!"

"Well, well!"

"Yes, I want to make another trade with you."

"No, got use for them ourselves; say, you wanted that sand blast for recutting files; I'll trade it to you for three of them engines."

"Nix, nix! cost $250 cold cash—we've got more tools now, and don't use files much; then, if we did, you could recut 'em for us, couldn't you, Davis?"

"'Course."

"Well, I'll tell you what I'll do; I'll throw in an air pump."

"Well, all right, send up that one this afternoon."

"Yes, have it any time."

"Good-bye!"

Skeevers hung up the 'phone and rung off. He went to his desk and made a few figures—then commenced to walk again.

"The dog-goned sand blast ain't much good anyway, recut files ain't no good—'ceptin' to give to an engineer, who allus wants a file; can't hurt nothin' with one of them—air pump ain't much 'count, but it goes; if it wan't for getting Massey on his ear, I'd unload that flexible shaft rig on Davis for something—I will yet—see if I don't."

Skeevers sat at his desk for ten minutes and made a sketch; then he walked through the shop leisurely and stopped, at last, beside Enoch Bridges' bench. Enoch is a young mechanic just out of his time, who seemed to Skeevers to be a man interested in his work. Enoch didn't sign the petition, because he was off when it was passed around, and he don't know just where he is yet; he likes Skeevers, but is afraid Skeevers counts him a kicker. Enoch is under suspicion by the old-timers, who stir the local pot; but he is trying to do the fair thing all around, and be decent—no easy job. He is repairing an asthmatic air pump, merely nods to Skeevers and goes on with his work.

"Bridges," said Skeevers, "will you come to my office in half an hour from now?—I want to talk with you."

"Yes, sir."

Skeevers wandered around for a while, and when he got back to his den, Bridges was just trying to pump the time-keeper as to what in Sam Hill was up.

"Bridges," began Skeevers, "can you take that boring bar and put it in first-class shape?"

"Why, yes sir."

"Can you keep it so?"

"Well, that's a hard question to answer; you know everybody uses it, and nobody takes care of it; but I suppose I could."

"Valve-seat planer the same?"

"Yes."

"Let's see, Bridges, you are making 27 cents an hour now, are you not?"

"Yes, sir."

"Would you object to making more—by a little extra work?"

"No, sir; I'd like it. Don't care for overtime, 'specially in summer; but I want to make more money."

"Well, I propose to take all the floor hands off and put them in the pit gangs; such jobs as they do I am going to put on piece work."

"Piece work! I'm afraid of the gang, sir—they kick up a ——"

"That's where the extra work will come in," said Skeevers, holding up his finger, "in keeping your mouth shut. I am going to put the jobs into separate hands anyway, piece work or no. None of them will know whether you get three dollars a day or ten, unless you are big enough fool to tell them. In a year they will all be howling for piece work. Now, I am going to do away with that flexible shaft rig, and put in little air engines. I'll give you one to run the bar and the seat planer with. Here's a sketch of a heavy chest that I propose to have built. One end will hold the planer and the other end the bar, with a place for small tools; on the center here we will make a little pipe crane, big enough to lift the planer, a chest or a cover; the whole on wheels—you won't need a helper. You can oversee this job yourself, and get it just to suit you. You will face every valve and seat and bore every cylinder, either here or in the roundhouse. I'll give you so much a cylinder or seat; at first it will be just half of what it costs now, and if you don't make an average of five dollars a day the first month, I'll add enough overtime to make it five. At the end of that time you and I will settle on a price that will suit us both. You can fix up for this work and nothing else, and I promise you there will be no cut after the first settlement; all the improvement you can make is your gain. One man is going to have that steam pipe job, and hire his own help; one man is going to have the rod work—at so much per joint—and so on to the end; no more floating floor gang for me. Each branch is going into the hands of one good man, who will be responsible for results—and I don't want any two-seventy men on these jobs—a man that can't make four dollars a day isn't the man for the work. You think this over until to-morrow, and let me know your decision. You struck me as a man likely to get out of a rut, and I'd like you to try it. Keep your own counsel, and let me know what you will do at noon, to-morrow. Good-bye."

"He's half scared to death," remarked Skeevers, as Enoch shut the door. "I wonder why it is that shopmen turn pale at the mention of the words 'piece work.' Why, every engineer on the road runs by the piece, and wouldn't run any other way. I know what it is, and you can't blame them; it's the greed of the bosses, that's what it is. They pay big at first to get the men to half kill themselves to do a lot, then they cut them down from that basis to just a trifle over day's pay; the mechanic makes 10 per cent. on the change, the company 500—'tain't honest. I'll give that boy a five-year contract if he shows a saving of 25 per cent.—and I know he'll save 50—and it will be signed by the general manager, see if it ain't, or my name's not Skeevers. That steam-pipe job's a —— "

"Misther Skaavers, sorr!" said Dennis Rafferty, foreman of the laboring gang, sticking his head into the door, "there do be a cayr load ave iron, pipes and biler sheets on the supply house scales. Shall oi dump it into the house or unload it where ye's want it, as ye did the lasth jag?"

"I'll go and look at it, Dennis."

"If ye's plaze, sorr."

Skeevers got up into the car and looked at its lading, and the longer he looked the hotter he got under the collar.

"Leave her where she is, Dennis, for to-day, and do something else. I'll see about it."

Then he went into his office and wrote the following letter to the purchasing agent:

WM. SHAVER,

Pur. Agt. G. A. L. R.R.:

DEAR SIR—We have in our yard a car load of material (car 1346) evidently not intended for us. If you will look over our requisition for the month, you will not find an order for any single thing contained in this car. Please order it away, and notify us when we may expect the material ordered.

Yours very truly,

JAS. SKEEVERS,

Act. G. M. M.

"You will get a red-hot one on that," said the time-keeper, as he pounded it out on the typewriter—"*Shaver is a nephew* of the old man!"

"I don't care if he's his mother."

Shaver didn't wait to write. The very next morning he jumped on the telephone (speaking in office parlance), and ripped Skeevers up the back. Skeevers kept cool, and let Shaver do most of the talking. Among other things, he announced that the "old man" would be home that night, and that he proposed to lay the matter before him. This just suited Skeevers; and he bid Shaver good-bye sweetly and hung up the 'phone.

To make a long story short, the "old man" did come home—leaving John Massey in the East. The purchasing agent told his story with indignation, a little of which the "old man" absorbed, and the "old man" 'phoned for Skeevers to come down in the afternoon. Skeevers went, loaded. The "old man" greeted him civilly enough, and sent out for the purchasing agent.

"Skeevers," said he, "I'm sorry to see you commence quarreling with the other departments so soon; that's a thing that

prevents many otherwise good men from going to the front. You run your own department, and let the other men run theirs—if there's anything that gets me wild it's quarreling between two departments, say the transportation and the motive power. Now, what's the matter between you and Shaver?"

The purchasing agent had come in and taken a seat.

"Mr. Wilder, I have no desire to quarrel with anyone. I believe that all hands should work to one end. Now, you wrote me from New York that you would hold me responsible for results in my department. Can you do that when I have no authority?"

"But you have authority, sir."

"How much authority has an officer who orders a pail when another officer can, unknown to him, change the order to a quart measure?"

"Has that been done?"

"Worse than that. Mr. Massey says nothing; if you told him to make a boiler out of bass wood, and carry 300 pounds pressure on it, he'd do it, excusing himself by saying it was orders. I feel responsible for the boilers I work on—and if one of 'em blows up, you will hold me responsible, and I'll hold myself responsible."

"I am building a new boiler for our night express engine, and I ordered certain materials that I considered necessary. Mr. Shaver, here, saw fit to change that order to the materials *he* thought necessary. The only question now is, who you will put in charge of the work, who you think the best judge? If I do it, I will be responsible, and not you. I shall decline to build a boiler of a design I am afraid of, or to use materials I think unfit."

"Pretty strong language, young man."

"I know it, sir, but it's necessary; there is scarcely an order from our shops that is filled with good material. Mr. Shaver's duties are to buy cheap, and he can't see a thing on earth but price. We have had worlds of trouble with flues. We have a Midland engine rented here, and she has less than half the trouble; she is chain-gaged with the rest, so it's not our peculiar service. She has charcoal iron tubes that cost twenty-odd cents a foot. We use a cheap steel tube that costs thirteen cents. This night express is our most important train; you know the importance of its connections. I want a boiler that will give the least trouble in service. Iron is better than ——"

"Now, Mr. Skeevers, that's all agents' talk; we've seen chemical tests that show steel tubes are far better than iron," broke in Shaver.

"Agents' tests?" asked Skeevers. "I don't care a cent for such proofs; we have the proof right on the road. We have more delays to trains than any neighboring road—why? Because we buy the cheapest brasses, the cheapest flues, the poorest babbitt and the cheapest coal."

"Mr. Skeevers," asked the old man, severely, "are you not a little out of your line? I'm not asking you for advice about purchasing everything in general. What is it you don't like in this car of material?"

"I don't want those cheap tubes; I ordered best flange plate for that boiler and got the poorest quality of steel rolled, not fit for tanks. I ordered Mushet steel for tools, and got some two-cent stuff that it's a waste of time to work up; I ordered a 9½-inch air pump, and got a double-barreled thing of a bastard make. Mr. Wilder, it's like this; either I know what's best or not, Mr. Shaver knows or not. I think my training has taught me what is needed, his has taught him how to buy the closest. I am just as interested in doing things cheap as he is. But if he cuts the price in first cost he shows it to you, and gets congratulated right there and then. I have to *live* with his cheap material, and keep it in running order; if it's poor the running repairs are high. Do you 'go for' Mr. Shaver? I guess not; you come to the shop, and want to know why our running repairs are higher than they were. Mr. Wilder, I'll illustrate it to you ——"

"That's it—give us one of them object lessons, Skeevers."

"You are a civil engineer, you built this road, and you don't ask Mr. Shaver's advice about track or bridge material. Suppose when you ordered that seventy-five pound steel, Mr. Shaver, and an agent or two, had come in here and tried to convince you that sixty-pound iron was the proper thing; because you had it before and it was cheaper, wouldn't convince—would it? Well, suppose Mr. Shaver didn't come in at all, but just ordered the sixty-pound iron—what would you say when you saw the yard full of it?"

"I think likely I'd swear, Mr. Skeevers—yes, in fact I know I would."

"Would you keep the iron and use it?"

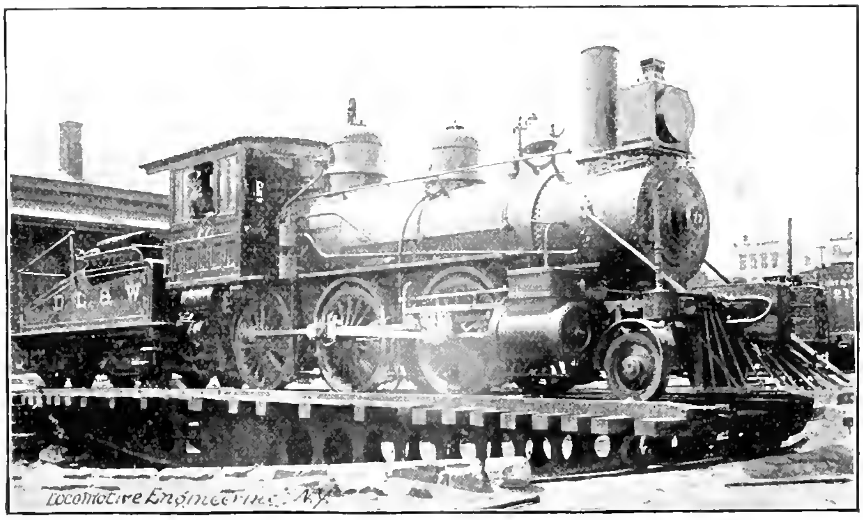
"No! and you needn't use that stuff. You're right about this."

"I can use the material for repairs, it's no worse than the stuff we have used; but I think the master mechanic should be allowed some discretion about the quality of material he uses."

"So he had, so he had; I'll fix this with Mr. Shaver. I'm coming up in the morning, Skeevers, to see what you've been up to while I was East. I hear you've raised the devil again." The old man pulled a drawer out of his desk and held out a box of cigars toward Skeevers. "Shaver," said he, "come up and take one, and smoke the pipe of peace; and Skeevers, let this be an object lesson to you—you do keep infernally bad cigars in your den up there; taste like they had oil on 'em."

A Helper Engine.

Our engraving shows a heavy helper engine, one of three recently turned out by Master Mechanic W. H. Lewis, of the D., L. & W., to assist passenger trains up Newark hill, 140-foot grade only about one mile long. These engines are fitted with air brakes, sand jet, bell ringers, steam heat, etc., so as to be able to take passenger trains through to destination in case of emergency.



Passenger Train Helper, D., L. & W. Ry.

At a recent meeting of mechanical engineers, held in New York, to discuss the compound locomotive, Mr. S. M. Vauclain, superintendent of the Baldwin Locomotive Works, stated that they had built over five hundred of his four-cylinder locomotives, and added: "It has been said that the compound locomotive is still in its infancy; this is doubtless true, and while we have from time to time had our full share of worries over sick children, I am thankful to say we have never yet had to mourn over a corpse—we have never changed one of our compounds back to a simple engine."

A Stay-Bolt Breaker.

The accompanying cuts show the general appearance and the details of construction of a pneumatic stay-bolt breaker constructed at the Missouri Pacific shops, at St. Louis, Mo.

By this device the time and cost of cutting out a firebox is brought away down in comparison with hand work.

The hook *F* forms one-half of a shear, the boiler plate the other half, and the bolt is sheared off clean and flat, close up to the sheet.

The whole device is suspended by the quadrant bail *G*, and can be tilted to right or left angles by placing the suspending chain in any of the notches shown. This chain, by the way, is fast to the piston of an air lift, the operating valve being within easy reach of the man operating the cutter, in order to raise and lower his machine. By use of the adjusting screw *A*, the machine can be balanced so as to require no effort on the part of the operators to keep it in position.

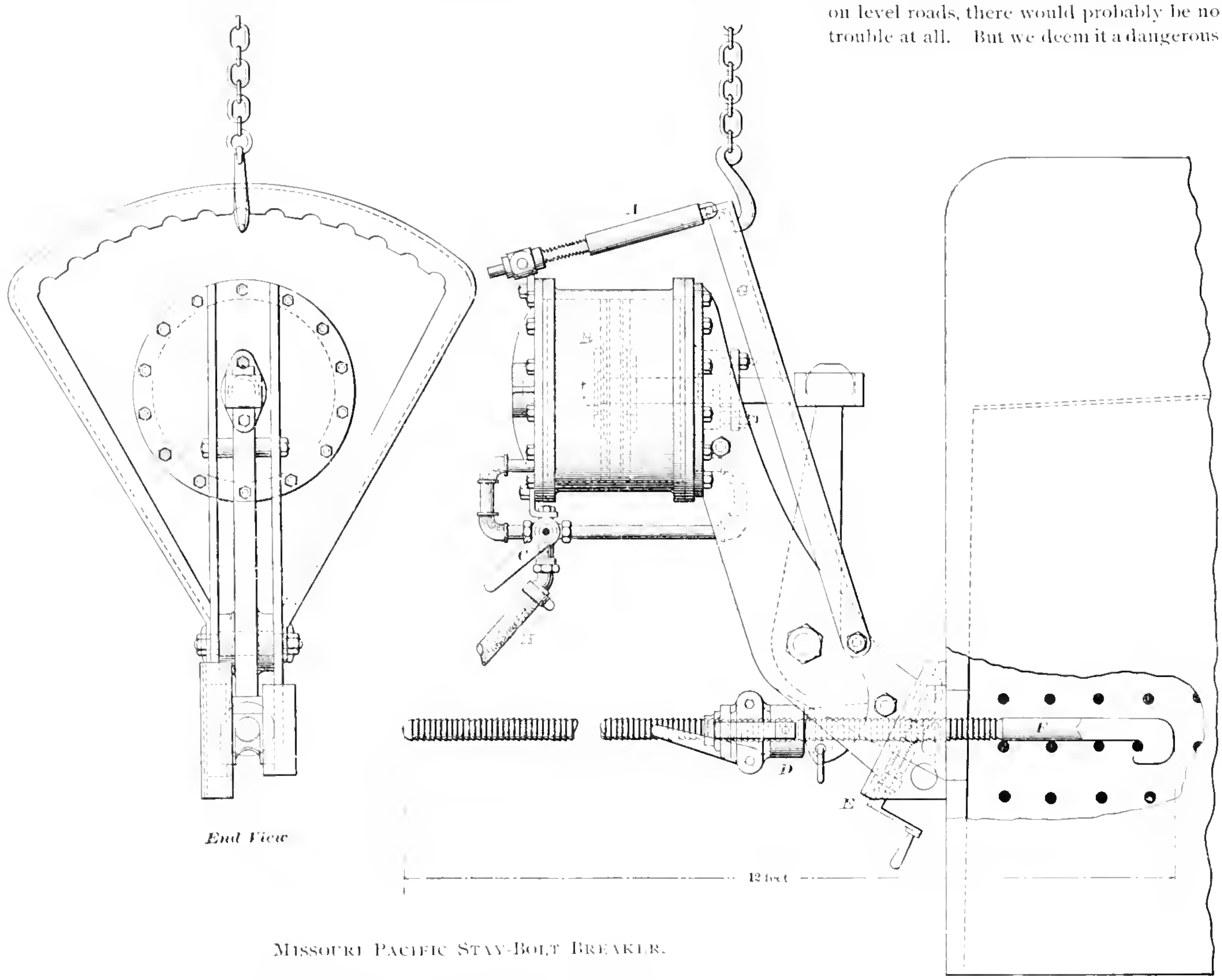
The taper slides, marked *E*, are the feet that brace against the boiler when pull is made, and are angled for the purpose of advancing one side, in order to rest one on the shell and the other on the firebox sheet, either on the right or the left side.

The hook and grooved bar, marked *F*, is of steel, and the hook is small enough to pass into the narrowest water space. The cam clutch, marked *D*, is opened and closed by the lever shown. When open, the bar can be moved forward or back by hand to catch the next bolt; the lever is moved, closing the clutch, and the machine is ready for work.

The cylinder *B* is 16-in. diameter and 9-in. stroke. Air is carried to it by a hose and through the five-way cock, marked *C*; this admits air to either end of the cylinder or exhausts it, and makes the machine quicker than where a spring is depended on for release.

The leverage used to multiply the power exerted by the piston is plainly shown in the drawing. Two men handle the machine at work; one attends solely to the hook bar, the other handles the air and adjusts the position of the machine.

We are indebted to Mr. Frank Reardon, superintendent of locomotive and car department of the road, for the print and information about it.



MISSOURI PACIFIC STAY-BOLT BREAKER.

⁂ ⁂ ⁂

There were required for this issue of LOCOMOTIVE ENGINEERING 186 reams of paper—18,600 pounds.

Doing Away with the Full Release Position.

One or two Eastern roads are contemplating, if they have not already done so, putting screw plugs in the quadrant of the engineer's valve to entirely prevent the handle being put into full release position. This will certainly cure the pernicious habit of carrying the handle there all the time, with one excuse or another, so persistently practiced by many engineers. There is no doubt at all that quick release can be had, even on long trains, through the excess pressure or the feed valve, and, on level roads, there would probably be no trouble at all. But we deem it a dangerous thing to do on any road where the grade is sufficient to cause a runaway if the brakes failed to hold—and they can fail with this arrangement. If the spring to the feed valve broke, or anything happened to prevent air going through the feed valve or the excess-pressure valve, no air could be got to the train pipe and trouble would ensue. We have always favored the little kink on the first Boyden valve, a spring that was compressed when the handle was placed in full release, but which forced the handle to running position the moment the engineer let go of it. Certain it is that the engineer should have a chance to get direct connection to his train pipe—it is the safest way.

Construction—The Automatic Electric Systems—*Continued.*

[SIXTH PAPER.]

By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

An automatic electric signal, with which, no doubt, the most of us are familiar, is the banner or clock-work signal shown in Figs. 1 and 2, it being the signal brought out by the Union Switch & Signal Co. to do away with the objections urged against a disk signal, and before the invention of the pneumatic signal.

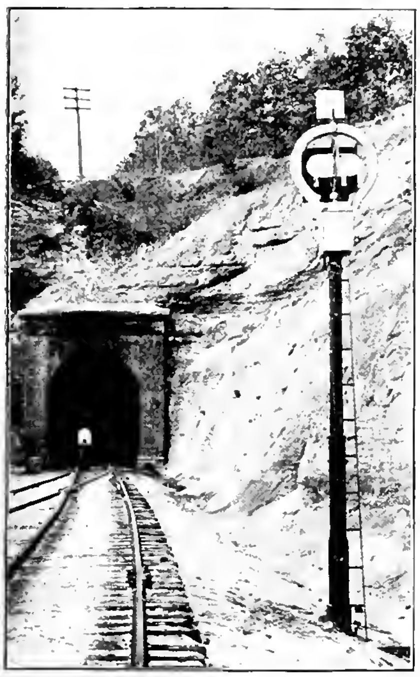


FIG. 1.

It will be seen that the signal is made up of two disks—one being circular and painted red for the danger signal, the other oval in shape and painted white for the safety indication. A square plate placed behind the disk and painted black, to make a good background, brings out very strongly by contrast the difference in the form of the two disks. The framework surrounding the disks is painted white, and also helps to bring out, in a way that is very effectual, both the form and color of the disk that is seen by an approaching train.

The two disks are fastened to a shaft turned by a weight and clock-work mechanism, the latter being placed in the box seen underneath the disk. The mechanism is alternately released and held by a magnet operated by the signal circuit, or the circuit controlled by the track relay, the disks being turned through a quarter of a circle for each change in the condition of the magnet, thus alternately presenting one disk and then the other in the direction from which a train would approach. If the block is clear, the circuit is closed and the oval disk is displayed, thus giving a safety indication; when the signal circuit is broken, the armature drops, releasing the mechanism which turns the shaft through a quarter of a circle, and the round disk or danger signal is displayed. An ordinary switch lamp, placed on top of the shaft, is used at night to give indications to correspond with those given by the disks.

The clock-work mechanism is shown in Fig. 3, the weight used for turning the signal being attached to a chain wound around the lower shaft, the shafts carrying the disks being placed on the spindle shown at the top of the figure. It will be seen that the armature of the magnet holds, at all times, one or the other of the two flops, which, when they are released, raise a catch holding one of the cross-arms of a shaft geared to the spindle, allowing this shaft to turn through a quarter of a circle, when it is caught by the other catch, the flop being held up by the armature. The weight is wound up by a handle made to fit on the square end of the shaft, seen in the cut, a threaded nut with a projecting pin being fitted to the shaft, and so made as to separate the contact points of two springs through which the signal circuit is run, and set the signal at danger if the weight is permitted to very nearly run down. This is done so that the signal will be left standing at danger when run down, as otherwise the signal might stop at safety and cause an accident by giving an "All Clear" indication when such was not the state of the block. The signal will give some 600 indications for one winding, or, in other words, it will indicate correctly the condition of the block for 300 trains passing it.

This signal is in use on a large number of roads, the Cincinnati Southern, the C., M. & St. P., and the Providence & Worcester having quite a number in service. However, it will, in all probability, never come into very general use, from the fact that there is too great a chance of its getting out of order and giving a wrong safety indication; not that it will very often fail to work, but that when it does so fail, it is almost as liable to give a safety indication as one indicating danger.

An automatic signal to be worth anything must be made so that it will very seldom get out of order, as trainmen will

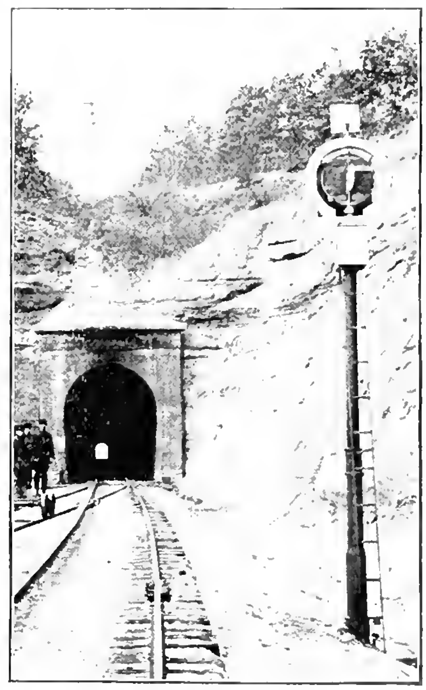


FIG. 2.

lose faith in it if they have to disregard its indications very often. But while everything will get out of order occasionally, particularly if not properly looked after, it does not follow that when a signal does get out of order it should ever show safety. Although the mechanism of this signal seems very simple and well put together, it can very easily become disarranged or get out of adjustment, and show safety when it should not; for if any one of the following things should happen to the mechanism, the signal is just as likely to stop at safety as at danger:

Sticking of the armature, from polarization, or the armature binding in the trunnions.

Jamming of the chain between the weight and the walls of the surrounding pipe.

Breakage of the chain, sticking of any of the parts, due to a lack of oil, accumulation of dust, etc.

There is one thing about the signal shown in the cut which is quite an improvement over some other signals of the same pattern made by this company, and that is in providing a disk to give the safety indication and making the signal one of form as well as of color. Many of the signals have only the one disk, that for indicating danger, in which case it becomes a color signal only; for when the signal is at safety, the edge of the disk is presented, and the background—with this pattern painted white—would be the only thing visible. If the background against which the signal was seen happened to be one presenting little contrast with the white of the signal—the sky, for instance—it is almost impossible to distinguish it until quite close, and while a danger signal

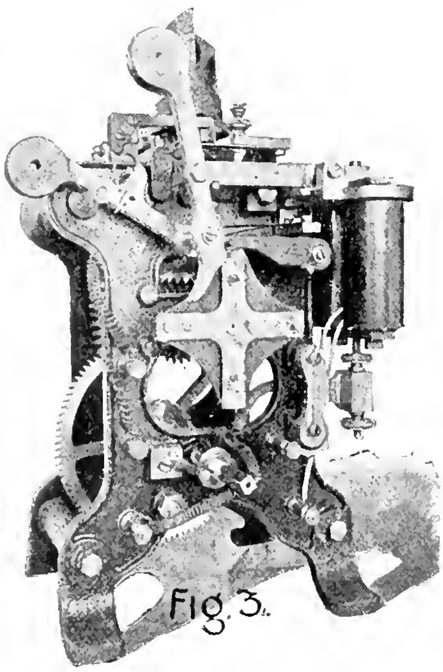


Fig. 3.

would be plainly visible, the safety indication would be very hard to make out.

With the signal shown in the cut, the safety indication can be plainly seen, irrespective of the surrounding objects, as the disk, being oval-shaped, would show very plainly against a black background surrounded by a white ring.

An automatic signal that is very interesting, as showing a new development in the application of electricity to the operation of a semaphore signal, by means of a motor, is shown in Fig. 4, the apparatus being the invention of Mr. J. W. Lattig, superintendent of telegraph of the Lehigh Valley R.R. The semaphore being recognized as the best form of day signal, and practically the standard signal of all the roads in this country, it is the hope of almost everyone that some cheap and efficient method of automatically operating a semaphore signal will be found, to place it within the reach of all; so that, looked at from this standpoint, this signal has much to commend it, and while the number that are in use is small, it is to be hoped that the results obtained will be such as to warrant a more extensive trial. As will be seen by reference to Fig. 5, the motor is mounted on the pole below the signal, the signal being cleared by winding up a wire rope attached to the balance lever, the signal blade being pushed by means of an up and down rod into the position indicating safety. The wire rope is made of phosphor bronze, and is wound upon a drum connected to the large gear wheel. This wheel is geared to the armature of the motor, to increase the leverage, and while it takes a longer time to do the work, it increases very greatly the lifting power.

To lock the motor after the signal has once been pulled to safety, and thus economize in the use of electricity, an ingeniously arranged worm gear is made to shunt the electric current from the armature of the motor to a magnet, Fig. 6, placed at one end of the armature shaft, a small circular armature being provided on the end of the shaft, so that when the magnet is energized it will be attracted and held, thus locking the gear wheels and holding the signal in the safety position.

Normally, the position of this signal is at danger, the idea being to use the current only when a train is approaching—a method of operating an automatic signal known as the "Normal Danger" plan, the several circuits of which will be spoken of later on. When a train approaches the signal, the track circuit relay closes the signal circuit, starting the motor and winding up the wire rope by means of the geared wheel and drum. When the signal has been brought to the safety position, the signal circuit is shunted to the magnet, shown in Fig. 5 above the large gear wheel, energizing it and attracting the circular armature, locking the armature and drum so that the rope cannot unwind, and holding the signal in the safety position. As soon as the train passes the signal, the signal circuit flowing through the magnet is broken, and the signal allowed to return to the danger position by gravity, the gearing and the motor revolving backwards as the rope unwinds from the drum.

The signal has been in service on the Central R.R. of New Jersey for over a year, and is reported as giving satisfactory results. As the motor is well boxed, there seems to be little chance of anything going wrong with it and causing it to give a safety indication when the block is not clear. The chance of this happening from snow or ice clogging the blade is very small, as the signal being normally at danger, it would be held in that position and not at safety, should sufficient ice collect upon it to prevent its working.

The battery, however, required is large, being eight to twelve cells of the Edison Leland type, to each signal, a fact that will most likely prevent the signal coming into any very general use. These cells are intended to be used on open circuit work, or intermittently, and would soon run down if the current was used continuously. They give a much more powerful current than the ordinary gravity cell, and are about the best cells to be had for this purpose on the market.

The Kinsman block signal system is one that it would be well to speak of, not so much for what has been done by the system, as from the several discussions that have taken place and the very generally expressed desire to have some definite information in regard to it. This is really not a signal system in any sense of the word, but one designed to stop a train by shutting off the steam and applying the air brakes without the help of the engineer, if there is a train in the next succeeding block, or the second block ahead of the engine. It is, of course, perfectly possible to work a signal in connection with the

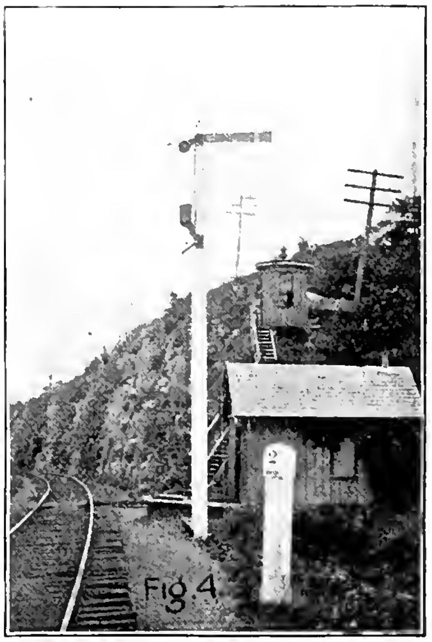


Fig. 4

electric circuits used, but this is not put forward as being in any way a necessary part of the system.

The circuits used are the same as those already spoken of in connection with the Westinghouse pneumatic signals, but with this difference, that the signal circuit, instead of opening a valve in the signal cylinder, trips a handle on the engine, opening an air valve and admitting air to a cylinder which shuts off the throttle and applies the brakes on the train.

A general view of the arrangement, as applied to an engine, is shown in Fig. 7, the special parts belonging to the system being the cylinder for closing the throttle, the magnet for opening the air valve when energized by a current of electricity, and the wire brushes attached to the equalizer of the engine truck, to pick up the current from a pair of guard rails placed on each side of the track, they being connected to the signal circuit battery, when the track circuit relay is demagnetized.

The circuits are arranged the same as for a home and distant signal, except that the current, in each case, is conducted to the guard rails instead of to the signals. As there were two signals, so will there be two sets of guard rails that are energized behind a train and which will stop a following train, should it pass over either of them.

When an application of air has been

Detail of Lattig Signal.

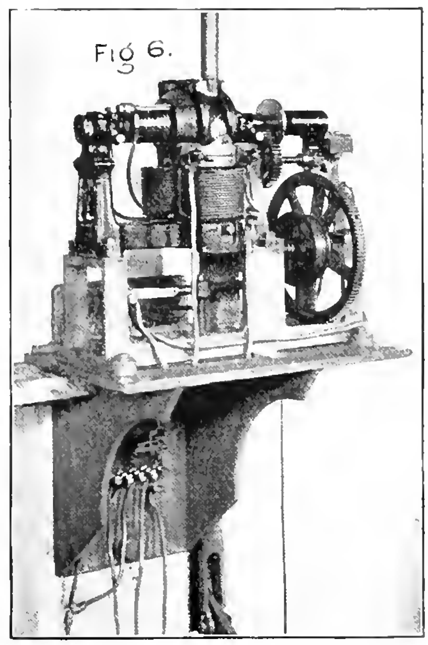
made, the engineer does not lose control of train, for the magnet is energized momentarily only, as the engine passes over the guard rails, and the engineer can pull up the handle, which will again be held by the armature of the magnet. This will release his air, and, by shutting the throttle lever home, making the latch in the air cylinder catch and make the connection between the levers and the throttle valve, he can again open the valve and admit steam to the cylinders. Of course, when the engineer does this and goes ahead, he must run with caution, expecting to find a train in the next block, or possibly a switch wrong, as causing the application of the air on his train. When doing so, he assumes all responsibility for the proper management of his train, and would be blamed for any accident that might result from his having gone ahead.

The track circuit and relays used with this system are arranged the same as with the signal systems, except that the signal circuit is completed instead of broken, when the track circuit relay is demagnetized, the armature making a back contact instead of a front one. As the normal condition of the armature is up, the normal condition of the signal circuit is broken; so that while the track circuit is continuous, the signal circuit is an open one, and is completed only when the armature is down and an engine is passing over the guard rails. This plan of having the normal condition of the signal circuit an open one is a very bad arrangement, and is very much like making the safety indication the normal position of a semaphore signal, for with an open circuit the danger application is the one that is positive, and not the one indicating safety. In other words, if anything should happen to this circuit and it should fail to give an application, a *safety* indication is made, and not one that will indicate danger; the circuit fails to safety instead of to danger. To be safe, the system should be normally clear and fail to danger—a fault which it is manifestly impossible to overcome, from the fact that the apparatus is placed on the engine, where a continuous current through the magnet cannot be used.

It is to be regretted that in the most extensive application made of this system, the relays used in connection with the track circuit were of a somewhat experimental form and one not well adapted to the work to be performed, or the number of failures, as gathered from the report read before the American Society of Civil Engineers, would not have been so large. In that report, it is stated that no failure of the system had occurred where the system had failed to indicate danger when it should have done so, and while this is probably true, there were several instances where it would have failed in this way had it so happened that one train followed another into the block.

There are many things which may happen to the signal circuit and to the several parts of the apparatus, any one of which will cause the system to fail to make an application, and in this way give a safety indication when danger exists. These are: Sticking of the armature of the track circuit relay, from polarization, or from the armature binding on the trunnions; giving out of the spring of the application valve; breaking of the wires at any part of the circuit, or loosening of the binding screws, breaking the connection; broken jar, allowing the liquid to escape; grounding of the current, the voltage being high; a piece of paper, dust or any non-conducting substance getting between the contact points of the relay; brushes failing to make a contact; waste catching in the teeth of the gear wheel, preventing the air valve from being turned; valve sticking, from lack of proper oiling.

In describing the circuits spoken of in connection with the several automatic electric systems, it has been supposed that the signals have been applied only to roads having double tracks, the trains on a given track all running in the same direction. It has also been taken for granted that the blocks were short enough to make it desirable to have a distant signal the length of an entire block away from the home signal. In many cases it is found that in looking over the ground preparatory to installing an automatic system, that this latter arrangement, owing to the length of the block, the consequent expense and the possible slowing up of trains, from their having to run the distance of almost two blocks apart, is not advisable; in which case it is customary to do away with a cautionary signal and make use of what is known as the overlapping section. To use an overlapping section is to practically extend the block past the next signal into the block ahead, the two signals



Motor for Lattig Signal.

standing at danger so long as a train remains on the overlapping section—that is, that a signal shall not return to the safety position until the train has not only entered the next block ahead, but shall have passed the signal the distance of the overlapping section, the section being of such a length as will give ample distance in which a following train could be brought to a stop, should it have approached the home signal at speed and found it at danger. In Fig. 8 an arrangement of overlap track circuits is shown, the overlap being of any length desired. *S* is the signal placed at the entrance of each block, *r* the relay and *b* the battery for the main track circuit, *t* being the relay and *c* the battery for the overlap section; *a* is the main bat-

tery operating the signal. It will be noticed that the relay for the overlap section is a double-point relay, the armature being provided with two contact points and making and breaking two separate circuits whenever the armature is attracted and released by the magnet. By tracing out the several circuits, it is seen that a train passing the signal and entering the overlap section puts the signal immediately behind it at danger, and keeps the signal at the entrance of the block it has just left at danger, also, for if the track circuit relay *t* is demagnetized, it will break the signal circuit to signal *s*–1 at *h* and to signal *s*–2 at *m*, and set them both at danger.

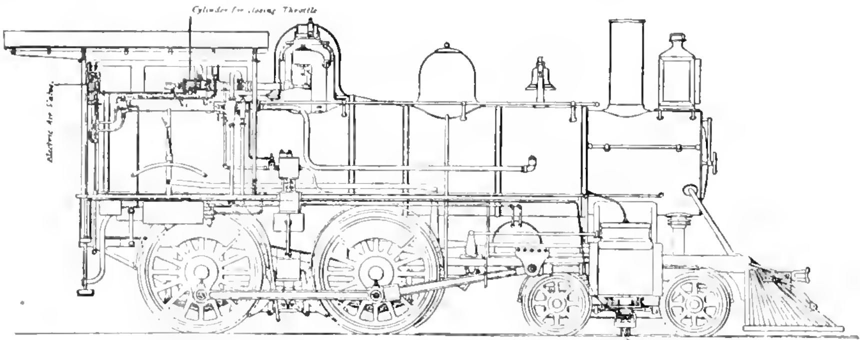


FIG. 7—LOCOMOTIVE EQUIPMENT OF THE KINSMAN BLOCK SYSTEM CO

When the train passes from the overlap section to the main track circuit, the relay *r* is demagnetized, breaking the signal circuit at *k*, keeping signal *s*–2 at danger, while signal *s*–1 goes to safety, in consequence of the circuit being restored at the point *h*, the armature being attracted by the magnet of the relay *t*, which became energized as soon as the train passed off the overlap section.

Thus, there will always be two signals at danger behind a train as long as it is on the overlapping section, and only one signal at danger when it has passed off the circuit on to the main track circuit of the block.

All the circuits that have been considered, so far, are those for use only on a double-track road, but when a single-track road is to be equipped other circuits must be used, as the conditions are found to be more complicated and very different, for not only must a train protect itself by setting the signals in its rear, but it must set the signals ahead of it at danger, also, for trains running in the opposite direction. Such a system of circuits is shown in Fig. 9, being those used by the Hall Signal Co. in several installations which they have made. This arrangement of circuits provides what is called by them "preliminary blocking sections," in which the second opposing signal in advance is set at danger by a train before it passes into the overlap section of the signal. Without this preliminary section it is possible for opposing trains to enter the block at or about the same time, in which case each engineer would suppose that the signal had been set at danger by his train, and a collision would most probably result.

With the use of the preliminary section this is impossible, as an engineer passing any signal would know that the track was clear for the block ahead and the preliminary section, also. If a train should enter the preliminary section at the same time that a train running in the opposite direction passed the signal of the block in advance, the signal at the entrance of the block in the face of the train on the preliminary section would be set at danger and that train would be stopped; the train in the block finding the next signal at danger would also come to a stop, and a collision would be prevented. By referring to the figure it will be seen that a train entering the preliminary section *n*, would put the signal *d* at danger by breaking the signal circuit at the contact *g*–1 of the track circuit relay *r*–1. On the train passing signal *a* and entering the track circuit *o*, the signal *a* would be put at danger by the relay *m*-1 breaking the circuit at the contact points *p*–1 and *s*–1, the signal *d* being kept at danger by a circuit breaker *x* worked by the signal *a*, so that while the contact is made by the relay at *g*-1, the signal does not return to safety. When the train enters the preliminary section *q*, the relay *r*–2 is demagnetized, breaking the circuit of signal *f* at *g*–2 and that of signal *a* at *h*–2, keeping the signals *a* and *d* at danger, while the signal *f*, the next one in advance, is put at danger, also.

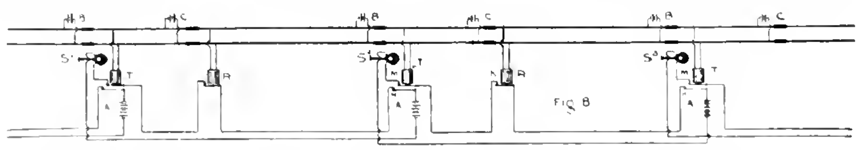


FIG. 8

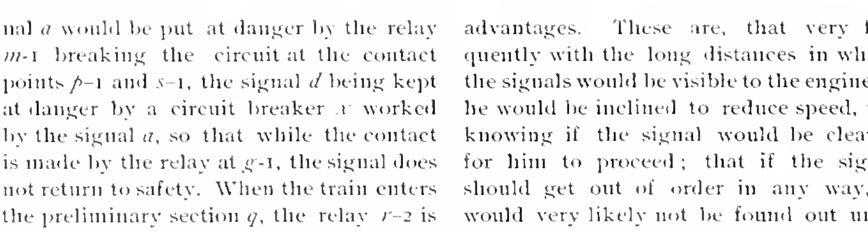


FIG. 9

To show more clearly the effect of the preliminary section, let it be supposed that a train should enter the preliminary section *n* just after a train running in the opposite direction has passed the signal *d*; when the train at *d* passed the signal, it put the signals *a* and *c* at danger by short-circuiting the relay, the signal *d* being set at danger by the circuit breaker worked by signal *a*. The train having passed signal *d* at safety, would, of course, proceed on its way, not knowing that a train was running against it in the opposite direction. Not so with the train on the preliminary section, for although it would put the signal *b* at danger as soon as it entered the section, it would find signal *a* immediately ahead of it standing at danger and would come to a stop. The train running from signal *d* to signal *b*, finding signal *b* at danger, would also come to a stop, the length of the overlap section, or the distance between the signals *a* and *b*, being the distance between the two trains.

An arrangement of circuits that is being extensively advertised by one of the signal companies is one known as the "Normal Danger" plan, the signals being normally at danger until the approach of a train, say, to within 2,000 ft. of the signal, when the signal will indicate safety, provided the block ahead is clear. Claims are made for it that it effects a great saving in battery power, the signal circuit being closed only when the signal is at safety, and that if the signal is at safety it is positive evidence to the engineer that the signal is in good order and that the track is clear, particularly if he has been able to see the signal change from danger to safety. While these arguments are, without doubt, very good ones, there are several objections to the arrangement that with many will considerably outweigh the advantages. These are, that very frequently with the long distances in which the signals would be visible to the engineer, he would be inclined to reduce speed, not knowing if the signal would be cleared for him to proceed; that if the signal should get out of order in any way, it would very likely not be found out until the approach of a train, thus causing delay, whereas if the signal was normally at clear, track men and others would be able to report the fact immediately the signal was found at danger without apparent cause; that track men and battery cleaners would know at all times, when maintaining the signals, that the circuits and batteries were left in good order, the fact of the signals being at clear being evidence to that effect. Again, defects are more easily detected and repairs made, the signal going to safety and indicating that

everything is all right, immediately the trouble has been remedied.

An arrangement of circuits that is in use on a good many roads, but one that is fast being done away with, owing to the superior advantages of a track circuit, is what is known as a wire circuit system, the signals being set at danger by means of a track instrument placed at the entrance of the block, and being cleared by a similar instrument placed at a certain distance beyond the next succeeding signal. Such an instrument is shown in Fig. 10; the wheels of a passing train striking the end of the lever which projects slightly above the rail, raises the other end and forces upward a piston inside the case, making or breaking the signal circuit, whichever it is intended to do, according to the position of the instrument relative to that of the signal.

This arrangement of circuits is certainly not to be recommended in comparison with a track circuit, since no protection from a following train is afforded should a train break in two, or back up after once passing the clearing instrument. No protection is afforded should a train on a side track not have pulled in far enough to clear the main line. And, again, such an arrangement of circuits would fail to give warning in case of a broken rail—a failure that is liable to occur at almost any time.

In the diagrams showing the several circuits, the signal circuits have been represented as extending the entire length of the block, but in actual practice this arrangement is not always used, owing to the increased resistance of the circuit, due to the length of the wires. By making the line wire into a separate circuit from one signal to the next, and using a relay to make and break the circuit of a local battery, the same results are secured and a saving in battery power effected.

With an automatic electric system, any switch in the block is very easily protected, the signal at the entrance of the block being put at danger when the switch is opened by attaching a circuit breaker to the points of the switch, so that the current through one rail of the track circuit, which is run through the contact points in the box, is not only broken, but the battery end of the broken circuit is connected with the other rail and an effectual short circuit formed. Bringing the wires of the signal circuit down to the switch box, instead of breaking the wires of the track circuit, while a very effective arrangement, is in many cases a more expensive one, and one that is not necessary, the chance of the others failing to act being very slight.

Visible indicators, worked by the signal circuit, should be placed at all switches on the main line, so that if an approaching train has arrived within a certain distance of the signal at the entrance of the block, the indicator will be set at danger, and warn anyone desiring to use the switch that a train is approaching. Automatic signals should be located entirely with reference to the character of the road and the number of trains that are run, the idea being to so space the signals as to make the running time through each block about the same. The plan of putting the signals very close together, if there are curves in the track, and very far apart where the signals can be seen, is a very poor arrangement, as it will often happen, owing to fog, snow or storms, that the signal cannot be seen until quite close to it, in which case trains following each other would be spaced the distance of the longest block apart, and not that of the shortest.

In placing signals at the entrance of a

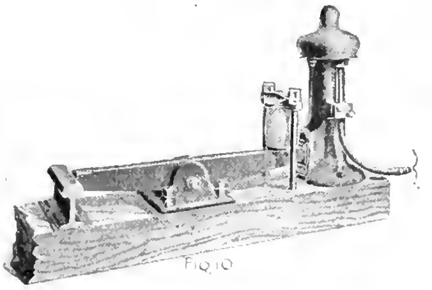


FIG. 10

block, it is a very good plan to put the signal a short distance beyond the beginning of the track circuit, so that the signal will go to danger before the engineer passes it, thus letting him see that it is working properly. Where this is done, any engineer stopping because the signal is at danger must be careful not to let his train run into the section controlling the signal, or the signal will not change to safety when the train keeping the signal at danger passes out of block.

Not According to Common Sense.

A correspondent objects to statements made in an article that appeared in the January number of LOCOMOTIVE ENGINEERING, concerning the varied temperature of the cylinders of a steam engine when at work. He says that it is all very well to write about these fine-drawn theories, but that a practical man knows that they are absurd. To teach that a change of 120° in the cylinder temperature takes place in one-tenth of a second is contrary to reason and common sense. Let us have facts, and no nonsense. He concludes: "If you are to put that kind of stuff in the paper, start your Ananias column again and put it under that heading, and then we will all know how to receive it."

To our critic we would cite the old saying, "There are things in heaven and earth not dreamt of in our philosophy" (the philosophy of common sense). The cooling and reheating of the cylinder during exhaust and admission is, to some extent, a theory; but its truth is so well corroborated by the results of experiment that there is no question about it among men who have devoted much attention to steam engineering.

Several builders of steam engines, particularly Westinghouse, Church, Kerr & Co., have conducted exhaustive experiments to find out the extent of condensation which results from the reputed cooling of the cylinders, and they found it great enough to show the theories on the subject to be correct. Chief Engineer Isherwood, of the U. S. Navy; Professor Reynolds, of England; D. Kinnear Clark and others, have shown cylinder condensation to be a very serious element of heat losses, and cylinder condensation cannot happen if there was not a cooling action. If further proof were necessary, it was supplied a few years ago by Mr. Bryan Donkin, of England, who perfected an apparatus which gave positive proof of the cooling and reheating of the cylinder. It was a special form of thermometer which indicated the varying temperature.

To the correspondent who elicited these remarks, and to others who are doubters concerning curious theories about heat and steam, we would say, read Professor Tyndall's "Heat a Mode of Motion." The book is as interesting as a novel, and contains no end of information about heat which every engineer ought to be familiar with.

We will add one practical illustration of how rapidly heat changes take place. We make a statement that a flash of heat passes over a surface 11 feet long at a speed of $\frac{1}{100}$ of a second per foot, and in that brief time five-sixths of the heat is absorbed. Common sense fires up at this statement and calls it another absurdity. Yet it is well known that the gases in a locomotive firebox pass into the tubes at a temperature of about 3,200°, and emerge at the smokebox end at about 700°. The speed of the gases is about 6,000 feet per minute.

The speed of steam is another curious thing that does not seem within the range of common sense. But it gets there all the same and bears incontrovertible testimony for itself.

You will travel a long time from one railroad shop to another before finding a better equipped plant than that of the C., St. P., M. & O., at St. Paul. The shops are full of the best and most modern tools; there is a good test department fitted up with all needed testing apparatus; the tool room equals that found in many good manufacturing plants—everything has the appearance of being up to date. We think their plan of blowing off their engines into an overhead pipe system, and using the steam for heating the house in winter and the water for boiler washing at all times, is worth imitating.

Are you making two applications of air on ordinary station stops? If you do, you are not a good air-brake man, and on many roads would be sent to the instructor. Practice a little, and see how easy it is to do the work with one application, if you try.

Mogul Freighter for the Fitchburg.

The Schenectady Locomotive Works recently turned out some excellently well designed moguls for freight service on the Fitchburg road. The management of this line have made a great reputation and increased their business wonderfully by offering to deliver to any point on their line by daylight any and all freight offered before six o'clock P. M.

These new engines are helping do that work.

The general dimensions are as follows:

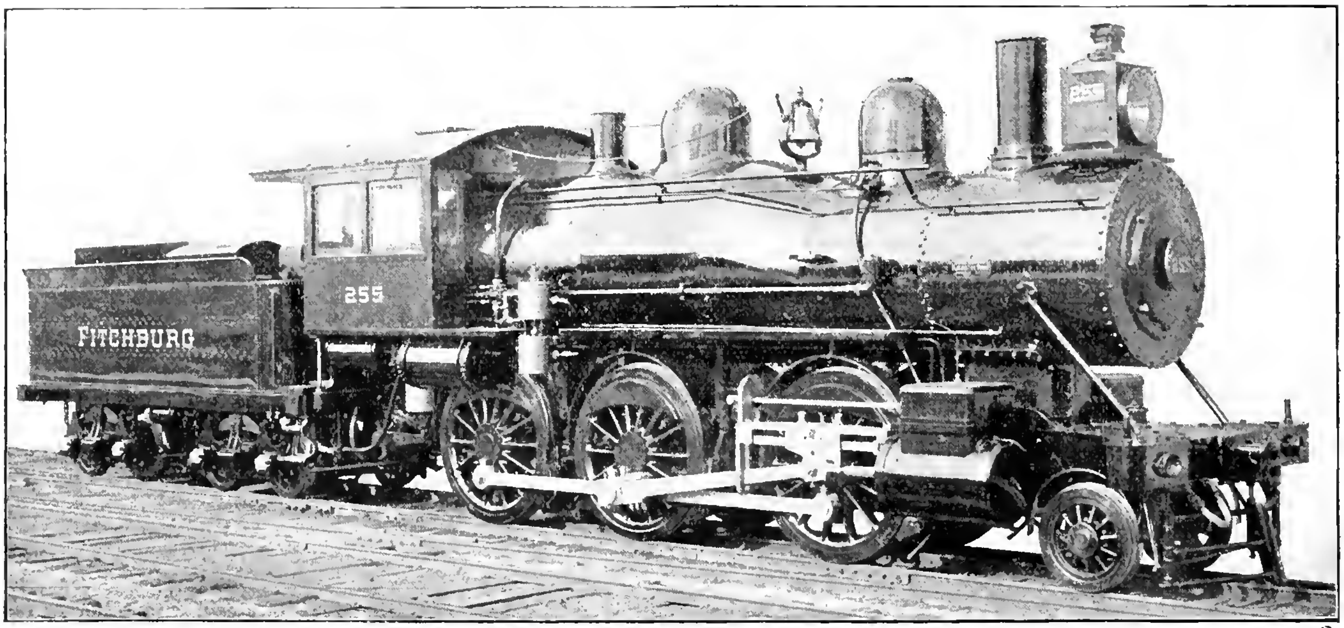
Fuel, bituminous coal.
Gage of road, 4 ft. $8\frac{1}{2}$ in.
Weight of engine in working order, 130,500 lbs.
Weight on drivers, 114,000 lbs.
Wheel base, driving, 14 ft.
Wheel base, rigid, 14 ft.
Wheel base total, 21 ft. 8 in.
Kind of engine truck wheels, Snow boltless steel-tired, spoke center.
Diameter and length of engine truck journals, $5\frac{1}{2}$ in. diam. by 9 in. long.
Diameter and length of main crank-pin journals (main rod), 6 in. diam. by 6 in. long.
Diameter and length of main crank-pin journals (side rod), $6\frac{1}{8}$ in. diam. by $5\frac{1}{4}$ in. long.
Diameter and length of F. & B. crank-pin journals, $4\frac{1}{2}$ in. diam. by $3\frac{3}{4}$ in. long.
Driving springs, for main and back wheels, hung underneath the driving boxes, 40 in. centers; for front wheels, placed above frames, 34 in. centers.

BOILER.

Style, extended wagon top.
Outside diam. of first ring, 60 in.
Working pressure, 190 lbs. per sq. in.
Barrel and outside of boiler material, Shoenberger steel.
Ash-pan style, sectional.
Exhaust pipe, single.
Exhaust nozzles, $4\frac{3}{8}$, $4\frac{1}{2}$ and $4\frac{5}{8}$ in.
Throttle, balanced valve.
Smokestack, I. D., 16 in.
Smokestack top above rail, 14 ft. $\frac{3}{8}$ in.
Boiler supplied by two Monitor injectors, P. R. R. standard, one No. 10 and one No. 9.

TENDER.

Weight, empty, 36,500 lbs.
Wheels, number of, 8.
Wheels, diameter, 30 in.
Wheels, kind, Snow boltless steel-tired, plate center.
Journal diameter and length, $4\frac{1}{4}$ in. diam. by 8 in. long.
Wheel base, 14 ft. 9 in.
Tender frame, S. L. W. standard, $6\frac{1}{2}$ x 4 x $\frac{3}{4}$-in. angle iron.
Tender trucks, 4-wheel, side bearings, wood cross beams.
Tank, water capacity, 4,000 gallons.
Tank, coal capacity, 8 tons (2,000 lbs.)



MOGUL FREIGHTER FOR THE FITCHBURG ROAD.

CYLINDERS AND VALVES.

Diameter of cylinders, 19 in.
Stroke of piston, 26 in.
Horizontal thickness of piston, 5 in.
Kind of piston packing, cast-iron rings.
Kind of piston-rod packing, United States metallic.
Diameter of piston rod, $3\frac{1}{2}$ in.
Size of steam ports, 18 in. long by $1\frac{1}{4}$ in. wide.
Size of exhaust ports, 18 in. long by $2\frac{3}{4}$ in. wide.
Size of bridges, $1\frac{1}{8}$ in. wide.
Greatest travel of slide valves, $5\frac{1}{2}$ in.
Outside lap of slide valves, $\frac{3}{4}$ in.
Inside lap of slide valves, $\frac{1}{32}$ in.
Lead of slide valves in full stroke, $\frac{1}{16}$ in.
Kind of slide valves, Richardson balanced.
Kind of valve-stem packing, United States metallic.

WHEELS, ETC.

Diameter of driving wheels, outside of tire, 63 in.
Tire held by shrinkage.
Diameter and length of driving journals, 8 in. diam. by 9 in. long.
Diameter of engine truck wheels, 30 in.
Barrel and outside of boiler thickness, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$ and $\frac{11}{16}$ in.
Horizontal seams, butt joint, sextuple-riveted, with welt strips inside and outside.
Circumferential seams, double-riveted.
Firebox length, $96\frac{3}{16}$ in.
Firebox width, $41\frac{3}{8}$ in.
Firebox depth, F. $62\frac{3}{4}$ in., B. $59\frac{3}{4}$ in.
Firebox material, Shoenberger steel.
Firebox material thickness, crown, $\frac{3}{8}$ in.
Firebox material thickness, tube, $\frac{1}{2}$ in.
Firebox material thickness, sides and back, $\frac{5}{16}$ in.
Firebox water space, front, 4 in.
Firebox water space, sides and back, $3\frac{1}{2}$ in.
Firebox crown staying, radial stays 1 in. diam.
Firebox stay-bolts, 1 in. diam.
Tubes, material, Franklinite No. 11 W.G.
Tubes, number of, 286.
Tubes, diameter, 2 in.
Tubes, length over tube sheets, 11 ft. 6 in.
Heating surface, tubes, 1709.6 sq. ft.
Heating surface, firebox, 138.5 sq. ft.
Heating surface total, 1848.1 sq. ft.
Grate surface, 27.66 sq. ft.
Grate style, rocking.
Total wheel base of engine and tender, 47 ft. $10\frac{3}{8}$ in.
Total length of engine and tender, 54 ft. $9\frac{3}{4}$ in.
Engine fitted with Westinghouse-American combined air brake on all drivers and tenders and for train.
Leach sand-feeding apparatus.

Was a Hot Job.

"I was called in the other day," said a well-known doctor, "to attend a typhoid fever patient. The man was a Scandinavian, a railway fireman, and was very sick. He was delirious for several days, and when I called and found him rational, I asked him how he had slept. With an effort, for he was very weak, he replied:

"'Ay hae bane dreaming al nite dat ay hae bane fireman for devil.' He paused a moment, and wiping the perspiration from his face, said in an impressive tone:

"'Ay tal yo dat hae bane dam hot yob.'"

A First-Class Man Wanted on Small Pay.

A most encouraging sign of improvement in business has come to us within the last two months, in the form of applications for good draftsmen and for men capable of taking charge of work. Among these was one inquiry which is worthy of comment. The head of a company wrote that he was looking for a man capable of taking charge of his machine shop. He was anxious to guard against mistakes, and he mentioned a few of the qualifications which the foreman ought to possess. In the first place he must be a first-class machinist, capable of doing the best kind of work on any machine, and equally skillful on vise work. He must be entirely familiar with piece work and a judge of prices, and he must be able to tell if men are taking all possible work out of their tools. As a matter of course, he must be a good shop manager, energetic and pushing, with an eye always open to carry out improvements. One who has displayed ingenuity in designing special tools for reducing the cost of production would be preferred. Sobriety and good moral habits are essential. If he is an engineering school graduate, it would be more satisfactory. The pay would not be large at first, but the prospects of advancement would be good.

The trouble about men with these qualifications is, that they are not lying around loose, even in the hardest of times. Another difficulty about engaging them is, that they are not under the necessity of taking an experimental job on small pay. Those who are looking for first-class men of this kind ought to understand that only first-class inducements will attract them.

We pay cash for getting up clubs.

Private Law-Makers.

A humorous story by Mark Twain was published about a year ago telling the experiences of a "reformer" who was opposed to sleeping car companies and other corporations making laws for the community, directing popular attention to this nuisance. It is amusing and sometimes exasperating to find how many people clothed in a little brief authority relegate to themselves the powers usually invested in legislative bodies. We were very much struck lately with an application of this tendency in reading "Rules and Regulations" of a machine shop, whose owners are noted for demanding legislative favors to aid in fostering their business.

The rules, as a whole, are drawn up on the assumption that workmen are a set of robbers. One rule says: "The firm will not be responsible for any injury that anyone may receive on their premises, nor for any accident that may happen from any cause whatever to anyone in their employ." Next one says: "Wages are paid in full, not only for work, but for all risks, dangers and damages of whatever nature, and for all claims upon the firm of every description."

Men who blazon drivel of this kind in their works are braying asses. The laws of the land are by no means too tender towards workmen, but they generally provide for damage in case of accident, if the employer is to blame, no matter what the printed "Rules and Regulations" may say.

Don't put down a wood floor in your roundhouse if it increases your fire risk and premiums. They are rotten and decaying nuisances, anyway, after a few years. Cement, asphalt or concrete are far better and safer.

A French Experiment of Long Ago.

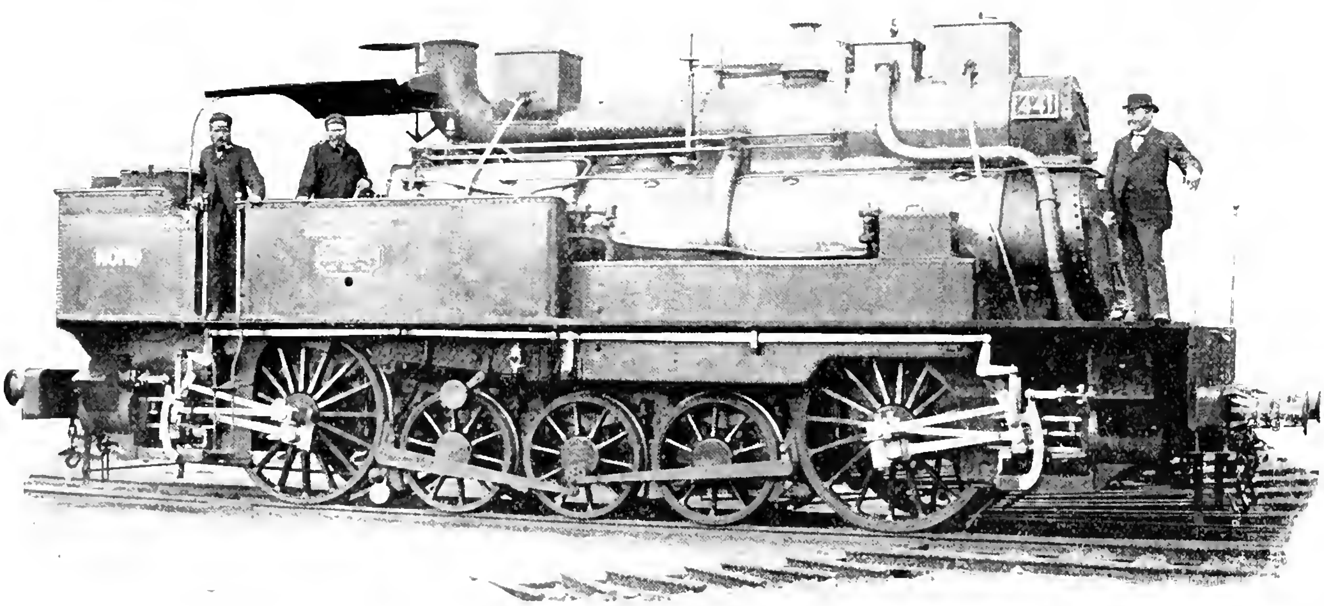
We won't attempt to explain the details of this two-ended scrap pile, that was one of several built by the Northern Railway France in 1862. It is interesting, however, to follow out the details of the design.

The conglomeration was a fearful and wonderful contraption, but—give the devil his due—it was not so bad as our own "Raub," just as reasonable as the "Fontaine," and not half so bad as some of the manure spreaders lately proposed to get rid of the counterbalance.

Solid Brass Driving Boxes.

It is not so easy to find enthusiasts on solid brass driving boxes as it used to be. Those who have tried them say it is not strictly true that four old ones will make three new ones, especially three good ones—there's a difference in the remelted metal. Again, they will get hot once in a while, and when they do, the metal expands more than iron; hence, it is necessary to run with loose wedges, and loose wedges mean a pound in the engine, which no good engineer likes. One superintendent of motive power, who has a good many in service, and who, three years ago, was very enthusiastic in their praise, said, the other day, that if he had it all to do over again he would use cast iron with crown brasses. Investigate a little—for some kinds of service solid boxes may be the best, for other kinds of work or other designs of engines not so good.

It does not pay to repair springs in the ordinary blacksmith shop. Credit for old springs makes new ones the cheapest in the long run. New springs have the advantage of the maker's guarantee—no loss for a bad temper.



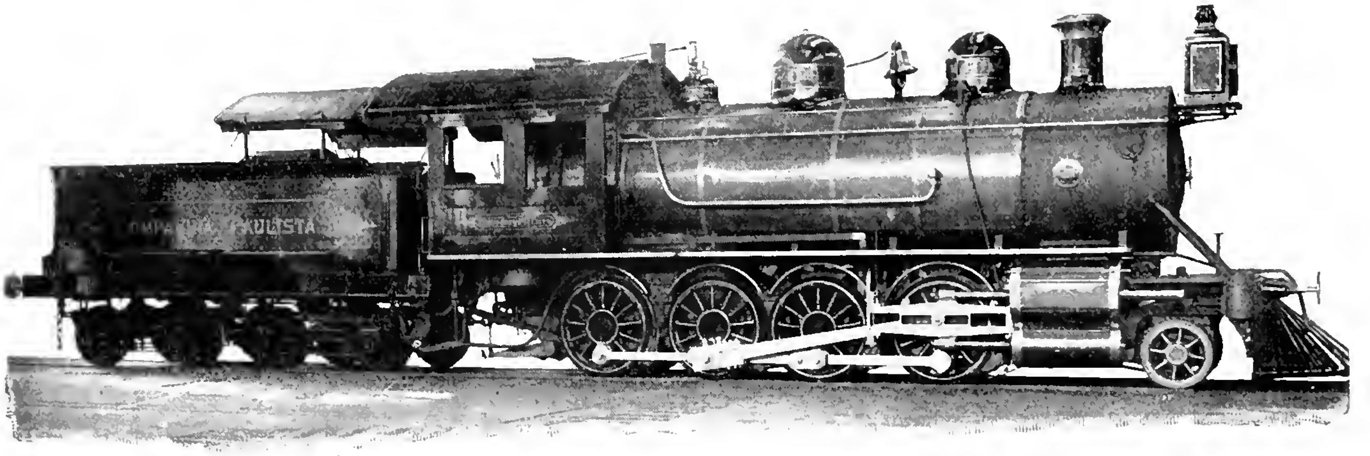
A French Experiment of Long Ago.

Heavy Compounds for the Companía Paulista, of Brazil.

The Baldwin Locomotive Works have recently shipped six heavy compounds, like the one shown in our engraving, to the Compania Paulista, in Brazil. These engines are monsters, as the following general dimensions will show:

Gage of track, 5 ft. 3 in.
Fuel, bituminous coal.
Boiler of steel, 76 in. diam., ¾ in. thick, designed to sustain a working pressure of 180 lbs. per square inch, with a factor of safety of 5.
Boiler tested by steam pressure to 200 lbs. per square inch, and by water pressure to 220 lbs. per square inch.
Firebox, 96¼ in. by 48½ in. wide; depth, front 63½ in., back 60½ in.
Material of firebox, copper.
Material of stay-bolts, copper.
Tubes of brass, 301 in number, 2 in. diam., 12 ft. long. One engine has tubes of hardened red copper, supplied by Messrs. Allen, Everitt & Sons.
Weight of engine in working order (without tender), 165,075 lbs., distributed as follows:
Weight on front truck, 19,600 lbs.
Weight on leading coupled wheels, 36,945 lbs.
Weight on second pair coupled wheels, 35,605 lbs.
Weight on third pair coupled wheels, 36,550 lbs.
Weight on fourth pair coupled wheels, 36,375 lbs.
Weight of engine, empty, 145,225 lbs.
Tank capacity of tender, 4,000 8⅓-lb. gallons.
Estimated weight of tender, 80,000 lbs.
Total wheel base of engine, 22 ft. 6 in.
Extreme spread of coupled wheels, 14 ft.
Total wheel base of engine and tender, 48 ft. 3 in.
Designed to traverse curves 300 ft. radius as a minimum.
Driving wheels, 4 pairs 50 in. outside diam., 44 in. centers; front and back pairs flanged 5½ in. wide; second and third pairs flangeless, 6½ in.
Driving-axle journals, 9 in. diam. by 9 in. long.
Cylinders, Vauclain compound system; two high-pressure cylinders, 15 in. diam. by 28 in. stroke; two low-pressure cylinders, 25 in. diam. by 28 in. stroke.
Truck wheels, 30 in. diameter; truck-axle journals, 5 in. diam. by 10 in. long.
Tender wheels, 33 in. diam.
Tender-axle journals, 5 in. diam. by 9 in. long.

These locomotives are equipped with the Westinghouse vacuum brake, Holt & Gresham sanding device, asbestos sectional boiler covering, Nathan automatic sight-feed lubricator and Korting injectors. We are not informed for what special service these remarkable engines are intended.



Heavy Compound Locomotives for the Compania Paulista, of Brazil.

Kindling locomotive fires with oil is a complete success, and the cost one-eighth that of using wood.

Finishing the Interior of Large Pipes for Air-Hoist Cylinders.

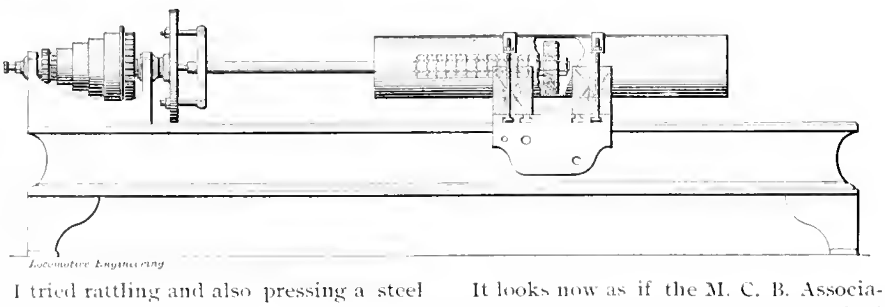
BY THOMAS FIELDEN.*

Air hoists are in common use now in almost every railroad shop, and no shop can get along economically without them.

Most of us must make our own hoists, and when it comes to large sizes the boring out of the cylinder is a problem.

Given a 10-in. pipe 10 ft. long to true up inside, and the average railroad shop equipment is unable to cope with it, without resort to some kink or trick other than the orthodox ways of doing it.

It is all important that the inside of the pipe be finished smooth enough to let the leather packing remain tight under load; in other words, it needs to be smooth and parallel, but not necessarily round.



I tried rattling and also pressing a steel plug through the pipes, but have had the best success by grinding out the pipe with an emery wheel, as shown in the sketch.

As a mandril for emery wheel, use a rough 1¼-in. rod of iron threaded 6 in. or 8 in. at one end, so as to fasten emery wheel on with a nut on each side of wheel; then fasten pipe on lathe carriage with clamps and blocks cut out to suit size of pipe; set bottom of pipe same distance from lathe center as radius of emery wheel used, which should be smaller than inside diameter of pipe. It will be understood that by weighting rod as indicated, at emery wheel end, that grinding will be done much faster. Put lathe on fast speed and ordinary feed, the emery wheel resting on bottom of pipe; run emery wheel through full length of pipe; then turn pipe one quarter of a turn, and run through again until all round the pipe. We have various hoists in use, from 6 in. to 14 in. diameter, ground in this manner. We have used any old pipe we had on hand for the purpose, and we congratulate ourselves on having tight air hoists, some of which have made fifty lifts per day for the past eight months, with no repairs or indications of any being required.

* General Foreman, Missouri Pacific Shops, St. Louis, Mo.

In our description of the C., St. P., M. & O. roundhouse and shop last month, we neglected to mention that the roundhouse had a first-class drop pit, with Vreeland transfer jack, and was heated by the Sturtevant hot-air system.

It looks now as if the M. C. B. Association would wipe out some of the fine-haired rules in the interchange system and adopt what is known as the Chicago plan, originated by Mr. J. N. Barr, superintendent of motive power of the C., M. & St. P.—to inspect for safety only. What is needed are more repairs and less cards—more mileage and less delays to traffic because the paint is faded somewhere on a box car.

Heavy Eight-Wheeler for the New Jersey & New York Road.

The Rogers Locomotive Company recently turned out the heavy passenger engine shown in our illustration. The following specifications will fully describe the engine:

Gage, 4 ft. 8½ in.
Fuel, anthracite coal.
Weight on drivers, 77,000 lbs.
Weight on truck wheels, 35,000 lbs.
Weight, total, 112,000 lbs.
Wheel base total, engine, 22 ft. 9 in.
Wheel base, driving, 8 ft.
Wheel base total, engine and tender, 47 ft. 7 in.
Height, center of boiler above rails, 7 ft. 7 in.
Height of stack above rails, 14 ft. 9 in.
Heating surface, firebox, 170 sq. ft.
Heating surface, tubes, 1,387 sq. ft.
Heating surface total, 1,557 sq. ft.
Grate area, 27 sq. ft.

WHEELS AND JOURNALS.

Drivers, number, 4.
Drivers, diameter, 64 in.
Truck wheels, kind, Taylor steel-tired.
Truck wheels, diameter, 30 in.
Journals, driving-axle, size 8 x 10 in.
Journals, truck-axle, size 5½ x 12 in.
Axles, driving, material, steel.
Axles, truck, material, steel.

CYLINDERS.

Cylinders, diameter, 18 in.
Piston stroke, 24 in.
Piston-rod diameter, 3¼ in.
Kind of piston-rod packing, U. S. metallic.
Main rod, length center to center, 7 ft. 6¾ in.
Steam ports, length, 18 in.
Steam ports, width, 1⅜ in.
Exhaust ports, length, 18 in.
Exhaust ports, width, 3 in.
Bridge, width, 1¼ in.
Exhaust pipe, single.

VALVES.

Valves, kind of, Richardson's balanced.
Valves, greatest travel, 5½ in.
Valves, outside lap, ⅞ in.
Valves, inside clearance, $\frac{1}{32}$ in.
Valves, lead in full gear, $\frac{1}{32}$ in.

BOILER.

Boiler, type of, wagon top.
Boiler, working steam pressure, 160 lbs.
Boiler, material in barrel, steel.
Boiler, thickness of material in barrel, ½ in.
Boiler, diameter of barrel outside at first course, 58 in.
Seams, kind of, horizontal, sextuple-riveted butt.
Seams, kind of, circumferential, double-riveted lap.
Crown sheet, stayed with crown bars.
Dome, diameter, 30 in.

TUBES.

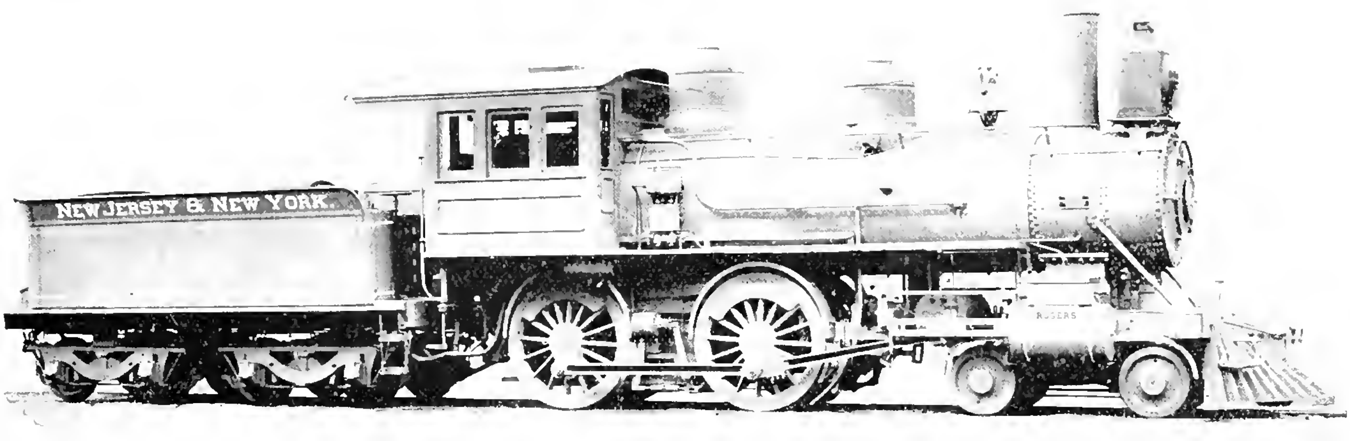
Tubes, number, 241.
Tubes, material, iron.
Tubes, outside diameter, 2 in.
Tubes, length over sheets, 11 ft.

FIREBOX.

Firebox length, 10 ft.
Firebox width, 2 ft. 9 in.
Firebox depth, front, 71 in.
Firebox depth, back, 59 in.
Firebox material, steel.
Firebox, thickness of sheets, $\frac{5}{16}$ and ⅜ in.
Firebox brick arch, none.
Grate, kind of, water tubes and pull-out bars.

TENDER.

Tank capacity, 3,000 gals.
Coal capacity, 8 tons.
Frame, type of, 9-in. steel channels.
Trucks, type of, "Rogers" type.
Wheels, kind, Taylor steel-tired.
Wheels, diameter, 33 in.
Axle material, steel.
Journals, size 4¼ x 8 in.



A JERSEYITE.

A Scale Fighter.

General Foreman Bancroft, of the C., S. & H. shop, at Columbus, O., has recently rigged up a device for cleaning flues that is found more efficacious than the usual tumbling barrel—the water in that district being so impregnated with lime that scale forms fast and is very hard. The writer saw a boiler in the shop that had just been relieved of twenty-three wheelbarrow loads of hard scale, each barrow weighing over 200 pounds, and this did not take into account the immense quantity on the flues.

Mr. Bancroft has rigged up a sort of a speed lathe out in a shed. This is provided with means for rotating a flue at a fairly lively speed; boys then hold on the tube spiral rolling cutters, held in a pair of hinged wooden levers, the whole thing looking something like a giant nutcracker. The spiral of the cutters feeds the device along, and the boys furnish the pressure.

This affair cleans a tube quickly and well. They save all their old copper ferrules for old metal, and pitted tubes are discovered and discarded before much work is done on them.

Polishing Journal Bearings.

In the car shops of the Panhandle road, at Columbus, O., they have an attachment on their double-headed axle lathes to buff the journal bearing, using corundum on a walrus-hide wheel. It is claimed this prevents hot boxes and costs less than three cents per axle. Equal or better results are had at the Missouri Pacific shops at St. Louis, by rolling the journal. A steel roller, about 4 in. in diameter, is carried on a pin through the forked end of a tool fitting the ordinary post; this plain wheel is forced against the work and rolls it down, producing a hard, close grain and a high finish in short order. Superintendent of Motive Power Reardon speaks highly of the results this device has caused in reducing the number of hot bearings—they use it on axles and pins of engines as well. It was devised by Mr. Thos. Fielden, the general foreman.

Railroaders "down East," where the water is so pure that they put something into it to scale a little, to prevent rusting, and where engineers give up their trains for a leaky flue sheet, can scarcely appreciate the grief their brothers in the hard-water districts endure.

An engine on the Omaha road once came in from a long, hard run, went to the coal chute and across the table into the roundhouse, and just as she got her stack under the smoke jack, one of her main driving wheels fell off; the axle was broken squarely off at the wheel hub. This is the finest example of a "lucky accident" we know of.

The reinforced brake is being put on the fast trains of the Pennsylvania Railroad between New York and Washington.

Heavy Anthracite Passenger Engine for the Delaware & Hudson.

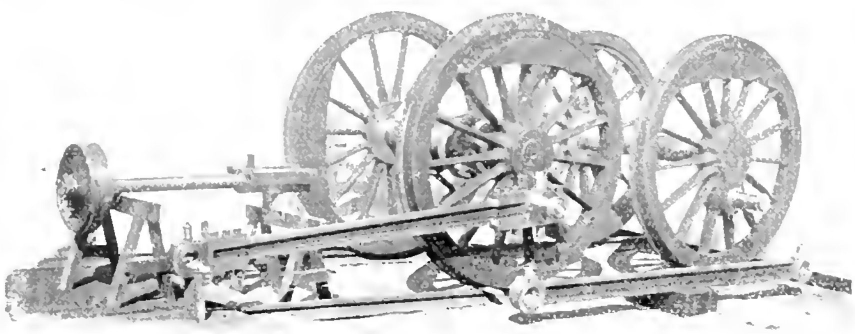
The locomotives illustrated by photograph, and described by the accompanying specifications, designed and built for the Delaware & Hudson Canal Co. by the Schenectady Locomotive Works, possess a number of points which show a marked improvement in design of the American type of locomotive for heavy, fast service.

As will be seen from specifications, the engine, being designed for use of anthracite coal, has a long firebox; but, unlike the usual practice for this type of firebox, the boiler does not extend through cab, but is so arranged that a foot plate is used, giving more convenient accommodations for engineer and fireman. In designing the engine, the builders' aim was to give the largest amount of grate and heating surface with the least possible amount of weight, to effect which very light forms of piston, crosshead, connecting rods and driving-wheel centers were used. The weights of the reciprocating and revolving parts are as follows:

Piston, with $3\frac{1}{2}$-in. rod,	301 lbs.
Crosshead,	156 lbs.
Main rod,	432 lbs.
Side rod,	241 lbs.
Main crank pin,	110 lbs.
Back crank pin,	104 lbs.

The driving-wheel centers are of cast steel and weigh about 600 lbs. less each than the ordinary cast-iron centers of the same dimensions. The reduced weight in revolving and reciprocating parts, and corresponding reduction of weight in counterbalance, together with light wheel centers, driving boxes, etc., makes a very easy engine on the track—in fact, no harder than the ordinary eight-wheel locomotive, having 9,000 lbs. less weight, or 75,000 lbs. on drivers. As will be seen by cut, the boiler is sloped down from the dome, and narrowed in at the sides toward back, reducing to a minimum the overhanging weight. The foot plate is of cast steel and very light. The driving boxes, eccentrics and straps are of gun iron, while a large number of the other heavy castings are of steeled iron, reduced in section to the minimum weight. The boiler is of the extended wagon-top type, but instead of heavy radial stays, has crown bar staying for crown sheet, this being specified by the road. The smoke-box front and door, cylinder-head casings, smokestack base and dome casing are of flanged steel. The engine is one of a lot of three built for use on the heavy, fast Saratoga and Montreal summer trains.

The general dimensions are as follows:



LIGHTENED RECIPROCATING PARTS.

Fuel, anthracite coal.
Gage of road, 4 ft. $8\frac{1}{2}$ in.
Weight of engine in working order, 123,500 lbs.
Weight on drivers, 84,000 lbs.
Wheel base, driving, 8 ft. 6 in.
Wheel base, rigid, 8 ft. 6 in.
Wheel base total, 23 ft. 1 in.

CYLINDERS AND VALVES.

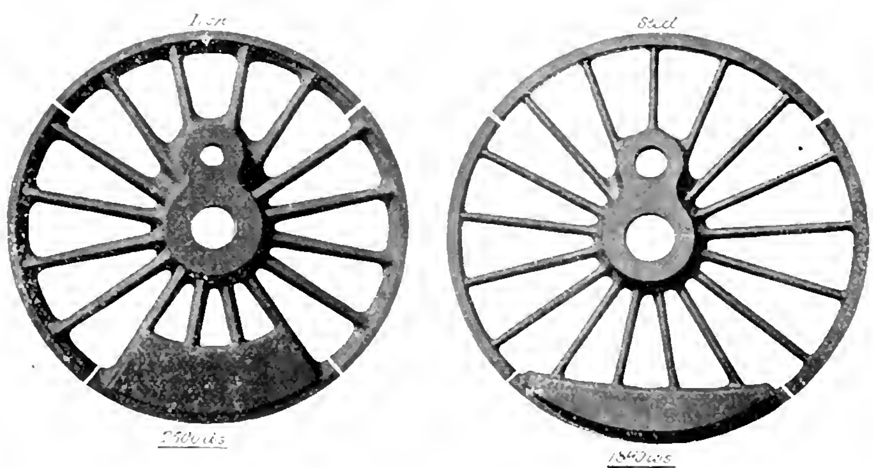
Diameter of cylinders, 19 in.
Stroke of piston, 24 in.
Horizontal thickness of piston, $4\frac{3}{4}$ in. at rim, $5\frac{3}{4}$ in at hub.
Kind of piston packing, cast-iron rings.
Kind of piston-rod packing, Jerome metallic.
Diameter of piston rod, $3\frac{1}{2}$ in.
Size of steam ports, 18 in. long by $1\frac{3}{8}$ in. wide.
Size of exhaust ports, 18 in. long by 3 in. wide.
Size of bridges, $1\frac{3}{8}$ in.
Greatest travel of slide valves, $5\frac{1}{2}$ in.
Outside lap of slide valves, $\frac{7}{8}$ in.
Inside lap of slide valves, line and line.
Lead of valves in full stroke, $\frac{3}{16}$ in. forward motion, $\frac{1}{4}$ in. lap back motion.
Kind of slide valves, Allen-Richardson balanced.
Kind of slide-valve stem packing, Jerome metallic.

WHEELS, ETC.

Diameter of driving wheels, outside of tire, $68\frac{1}{2}$ in.
Material of driving-wheel centers, cast steel.
Tire held by shrinkage.
Diameter and length of driving journals, 8 in. diam. by 11 in. long.
Diameter of engine truck wheels, 33 in.
Diameter and length of main crank-pin journal, $5\frac{1}{2} \times 5\frac{1}{2}$ in.
Diameter and length of side-rod crank-pin journal, $4\frac{1}{2} \times 3\frac{1}{2}$ in.
Driving-box material, gun iron.
Engine truck wheels, Boies steel-tired, solid center.
Driving springs, hung underneath the driving boxes.
Driving-spring centers, 42 in.

BOILER.

Style, extended wagon top.
Outside diameter of first ring, 60 in.
Working pressure, 180 lbs. per sq. in.
Material of barrel and outside of firebox, Otis steel.
Thickness of plates in barrel and outside of firebox, $\frac{9}{16}$, $\frac{5}{8}$, $\frac{7}{16}$ and $\frac{1}{2}$ in.
Horizontal seams, sextuple-riveted, with welt strip inside and outside.
Circumferential seams, double-riveted.
Firebox length, $132\frac{3}{16}$ in.
Firebox width, $40\frac{3}{8}$ in.
Firebox depth, $68\frac{1}{2}$ in. front, $55\frac{1}{2}$ in. back.
Firebox material, Otis steel.
Firebox thickness, crown $\frac{3}{8}$ in., tube $\frac{5}{8}$ in., sides and back $\frac{5}{16}$ in.
Firebox water space, front 4 in., sides and back $3\frac{1}{2}$ in.
Firebox crown staying, crown bars 5 in. wide, $\frac{3}{4}$ in. thick.
Firebox stay-bolts, U. S. iron $\frac{15}{16}$ in. and 1 in. diam.
Tubes, material, charcoal iron No. 12 W. G.
Tubes, number of, 288.
Tubes, diameter, 2 in.
Tubes, length over tube sheets, 11 ft. 2 in.
Heating surface, tubes, 1671.2 sq. ft.
Heating surface, water tubes, 71.2 sq. ft.
Heating surface, firebox, 187.7 sq. ft.
Heating surface total, 1930.1 sq. ft.
Grate surface, 37.2 sq. ft.
Grate style, water tubes and pull-out bars.
Ash-pan style, hopper with open ends.
Exhaust pipes, double, high.
Exhaust nozzles, $2\frac{7}{8}$, 3, $3\frac{1}{8}$ in. diam.
Throttle, balanced valve, single.
Smokestack, I. D., 18 in. at top, 16 in. near bottom.
Smokestack, top above rail, 14 ft. $1\frac{1}{4}$ in.
Boiler supplied by two Nathan injectors, one No. 10 R. S., one No. 9 L. S.



WHERE 2,440 POUNDS WERE SAVED.

TENDER

Weight, empty, [illegible] lbs.

Wheels, number of, 8.

Wheels, diameter, 36 in.

Journals, diameter and length, [illegible] in. diam. by [illegible] in. long.

Wheel base, 15 ft. [illegible] in.

Tender frame, 5½ x 4 x [illegible]-in. angle iron.

Tender trucks, channel iron, center bearing.

Water capacity, [illegible] gals.

Coal capacity, 8 tons.

Total wheel base of engine and tender, 49 ft. [illegible] in.

Total length of engine and tender, [illegible] ft. 10[illegible] in.

Engine fitted with American outside-equalized brake on all drivers, operated by air.

Westinghouse automatic air brake on tender and for train, 9½-in. air pump; engineer's air signal.

Consolidated steam-heating apparatus.

Trojan coupler on front of engine and rear of tender.

Leach sand-feeding apparatus on sand box.

Cory's patent force-feed lubricator for oiling all bearings.

A few months ago, one of the largest railroads running out of New York made an elaborate investigation, covering several months' time, in order to find the exact amount of oil used as compared with the amount supplied. The result showed conclusively that more than thirty-three per cent of the lubricating material was lost by carelessness in handling, overfilling the boxes, leakage from the rear end of the boxes on cars, and being thrown off on the wheels and tracks by centrifugal action. This fact would make it apparent that an invention greatly to be desired is one which would keep the oil from escaping round the journal. There are many dust guards in use, but the right one does not seem to have made its appearance yet.

Scrambled Railroad Equipment.

There's a road down in Ohio that would make a fine freak for some dime museum to exhibit to exclusive audiences of railroad men as an awful example of how a road's equipment can run. We refer to the Columbus, Sandusky & Hocking.

This road is [illegible] miles long, has fifty-two engines, fourteen of which are out of order, and nearly 2,000 cars. We don't know how many kinds of cars they have, but they have a dozen, more or less, kinds of engines, and the variety of details is simply astonishing.

The projectors and managers of the concern have been, we understand, awful nice men, as nice men go, but without experience in the management of railroads.

The shops are equipped with ancient tools that have been through a fire—not even a modern drill press in the outfit. The big single-head lathe used for this work is one of the old-time skeletons, that have seen service since '51—the other tools match it. But the shop is not the worst example.

On the many kinds and sizes of engines, from the two new compounds to the old pelter in the graveyard, back of the shop, you will not be able to find two injectors of the same size, and it's altogether likely that you can't find two of the same make on an engine. All the experimental affairs have been "tried" here, and one or two "odds" have been left over.

There are several kinds of lubricators, and all kinds of rod cups.

There were three kinds of air brakes that we noticed in a half hour's stroll—perhaps there are more. Think what it must cost to keep up repairs and do work on this diversity of apparatus! All the kinds and sizes of pumps made by Westinghouse, with a sprinkling of New York [illegible] to make the air-brake work interesting.

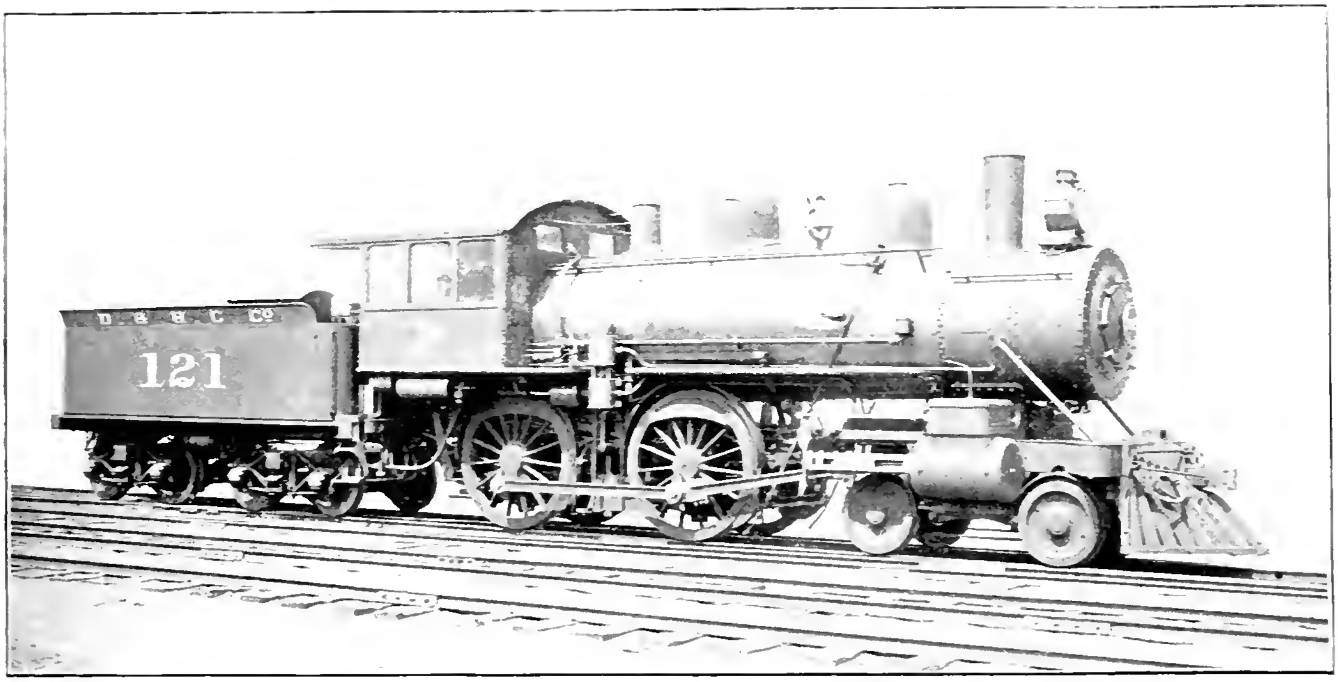
The purchasing agent seems to have been a good-hearted soul, who couldn't say "no" to anybody; tried a sample of everything, and the mechanics are now living with the ill-begotten assortment.

The road is in bad shape financially, which is not to be wondered at, and at last a physician, in the shape of an experienced railroad man, has been called in. It is to be hoped the new superintendent will have the nerve, the authority and the money to scrap a whole lot of stuff there, and start over fresh with something resembling standards—at least enough so that an extra injector could be put on an engine without tapping new holes in the boiler or changing all the pipes.

Amateur railroading is all right, and anyone with the means has a right to "go in for" that sort of thing; but it's tough on the real railroaders, who have to take the scrambled equipment and get results out of it.

We mention the name of this particular road right out in meeting, because it's a point in view—an example; and anyone who doubts the truth of these statements can just drop around at their shops, at Columbus, O., some rainy afternoon, and they will vote at once that "the half were never told."

Pintsch gas headlights are being tried on several roads in this country. This light is always ready; only needs lighting—no oil to get afire, or wick to work up, smoke and get the whole apparatus afire. In Germany this light is used in the signal lanterns and gage lamps of all passenger engines. Let it come—it saves time, work and worry, and insures a good light.



HEAVY PASSENGER LOCOMOTIVE FOR THE D. & H.

LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Weak Points in Locomotive Boilers.

A well-known superintendent of motive power, who has been investigating the strength of boiler seams, remarked to the writer a few days ago that he had found boilers with seams which were not more than 58 per cent. of the strength of the sheets they were joining together. This is an alarming condition of affairs, and is no doubt due to the fondness of the average American railroad mechanic for the lap joint. When thin sheets are riveted together by a lap joint, the seam may be made over 90 per cent. of the strength of the sheets, but as the sheets are made thicker the proportion of strength of the seam in relation to that of the sheets becomes smaller. A boiler made of 5/8-inch iron has much weaker seams if they are formed by lap joints than a boiler made of 3/8-inch iron or steel. Ignorance of this fact has no doubt been responsible for the building of boilers with seams little more than half the strength of the sheets.

In railroad shops, where a few new boilers are built every year, the judgment of the foreman boiler-maker is often relied upon in the building of a safe boiler much more than calculations. He is generally a man to be depended upon for turning out good work, but his judgment is not to be relied upon concerning the strength of seams or of material suitable for successfully enduring great strains. A chief draughtsman, or mechanical engineer, is a much safer adviser when questions come up that can only be settled by careful computation.

Lap joints ought not to be made for sheets half-inch or more in thickness. Not only is the joint inherently weak, but it produces a second dangerous line of weakness which may escape detection until rupture happens.

As soon as a boiler is put into service, it begins, slowly of course but surely, to tear itself apart. There are weak parts where deterioration concentrates. With lap joints and high steam pressure the sheet at the edge of the seam begins to suffer. The sheets on the seam cannot be made perfectly cylindrical and the joint is stiffer than the adjoining sheet. The boiler pressure has a tendency to straighten the sheet at the edge of the joint which induces a little movement of the metal and causes corrosion. It is a fact well demonstrated, that any part of a metal structure subjected to constant bending, will, after a time, break. In the case of a boiler sheet, this action causes corrosion which shortens the service of the sheet. That this is no idle hypothesis is proved by butt-jointed seams having almost no corroding influence upon the adjoining sheets.

The edge of the sheets adjoining a stiff lap joint ought to be very carefully watched, and rigidly inspected at every opportunity. An old locomotive builder told the following incident, which shows that too much care cannot be directed to watching the points where furrowing is most likely to be going on. He said: "I was in a railroad repair shop, and the master mechanic took me round the shop to see the engines and the work going on. There was an old engine undergoing repairs, and a man was at work drilling some 3/8-inch holes a couple of inches from the edge of a lap joint. I asked what the man was doing, and was told that a slight weep had appeared there, and the master mechanic thought it was probably pitted a little in the inside, and he was putting on a small patch. I expressed the opinion that there was furrowing along the seam inside, but he differed from me and thought a small patch was sufficient. I read in the papers, about four weeks afterwards, that the boiler of that engine had exploded. I was anxious to find out if my judgment was correct, so I went and examined the boiler. I found that the sheet ruptured along the seam where the weep was, and it led to other weeping of a heart-breaking kind."

We examined a boiler that blew off the dome a few years ago, and found convincing evidence of the weakening effect of bending action. The dome was large and its fastenings were badly designed, with the result that there was bending round the edge of the ring. Two years and a half of service was sufficient to weaken the boiler sheets so much that the dome went into the air.

Furrowing at the edge of seams is a very serious matter. Constant vigilance is necessary to prevent it from becoming a fatal weakness. As a boiler defect it is second only to broken stay-bolts. Locomotive boiler explosions have been notable for their rare occurrence during the last year, and we attribute this gratifying condition to have been in a great measure due to the attention devoted by the associations and clubs to discussing the causes which make boilers dangerous. Owing to the light thus thrown upon the subject, boiler inspection has become much more systematic than formerly, and attention has been given to the selection of efficient men as boiler inspectors. Under the old idea, any boiler-maker competent to calk a seam was considered competent to inspect boilers. The lives of enginemen and the property of the companies were often sacrificed because the boiler inspector could not tell by the hammer test when a stay-bolt was broken. There may still be incompetent men inspecting boilers, but they are getting to be weeded out. The tendency to test men's efficiency by an examination has taken in the boiler inspector. On some roads it has become the practice to give the best kind of a practical test to their boiler inspectors. When a locomotive is brought in to have a new firebox, the inspectors are required to test all the stay-bolts and mark those which they think are broken. When the firebox is taken out, an examination is made to see how near the different inspectors came to detecting all the stay-bolts that were broken. If any man displays incompetency he is put to other work. It pays to keep efficient men on boiler inspection.

The ablest men having long experience with boilers are almost a unit in the belief that broken stay-bolts have led to more explosions of locomotive boilers than all other causes combined. The first requisite to keep stay-bolts safe is good material. Those who purchase inferior iron for stay-bolts are guilty of heartless recklessness. Steel has proved the poorest kind of material for stay-bolts; yet we hear that the savage demand for reduction of expenses in the last year has led some roads to resort to steel for stay-bolts. We should think that the men responsible for this action would suffer from nightmare.

A well-known authority, speaking on the safety of boilers, said: "I use iron for stay-bolts that costs $6\frac{1}{2}$ cents a pound in the bar. I don't think that any locomotive builder, unless he was tied down tight by specifications, would pay over $2\frac{1}{2}$ cents for stay-bolt iron. That expenditure, in the first instance, is well repaid in the better wear and avoidance of repairs. We all know the expense of taking out a broken stay-bolt and putting in a new one. Then the hole is enlarged, and a thicker stay-bolt has to be put in. The danger from broken stay-bolts is very serious. I was called a few months ago to examine a boiler that had exploded and killed three men. The side sheet had pulled off from the stay-bolts and gone across the furnace.

and lay against the sheet on the other side, so that there was a good chance to make a thorough examination. There were nineteen broken stay-bolts in one bunch. There were six or seven in the immediate vicinity almost broken, and nine that had been put in new only a week before.

"The investigation showed that the boiler inspector had tested these stay-bolts and found nine broken. New ones were put in, but he failed to find the other nineteen that needed to be replaced; the consequence was an explosion and three dead men."

These are lessons that clear the way for reform; but that will not be effected unless full publicity is given to the real cause of disaster. Discussing the real cause of boiler explosions has in two or three years done more to reform the system of boiler inspection than all the experience with high-pressure boilers of the previous sixty years. The full light thrown on the subject has brought systematic inspection by competent men; it has brought into popularity the use of good iron for stay-bolts and of hollow or drilled stay-bolts; and in the near future it will stop the use of boiler seams that produce the furrowing action which is a menace to the safety of highly pressed boilers.

The Private Car Line as the Blood-sucker of Railroad Earnings.

American railroads haul more freight more miles for a dollar than any railroads in the world. Just now, the ablest railroad managers are pointing out the folly of such a course, and advising an advance of rates—something that undoubtedly ought to, and eventually will be done.

But why is it that no railroad officer has raised his voice against the means provided to extort from the roads a large percentage of their legitimate earnings—the private car lines?

The answer to the question is plain. The average operative officer knows somebody "up higher" is interested in some "line"—he don't know just whose toes he will tread on, so he keeps still.

He knows that a large part of the freight going over his road is hauled in "line" cars, for which the railroad pays so much per mile on cars, hauls them back empty, free, at almost passenger speed, and only receives pay for the weight of their lading, at the lowest figure a freight agent can make.

Instances are not so rare—indeed, they occur often—where the mileage paid by railroads on refrigerator cars between Chicago and the Atlantic seaboard *exceeds* the amount received for freight contained in the cars.

It is not unusual for one of these heavy cars to be hauled two thousand miles, for less than a quarter of a load, in one direction. If the road owned the car it would be filled with something in Chicago, and would be utilized also to carry clean freight back to the West.

Our railroads are hauling all kinds of "line cars," freight, stock, refrigerator, furniture and tank cars, at a profit to the line car owners in every case, and a loss to the railroads in nine cases out of ten.

Private car companies are not only pirates in taking the legitimate business of the roads—they are responsible for much mixed and inefficient equipment, and a large percentage of the freight train wrecks. If their cars wear out, they expect the railroads to renew or repair them; if they are damaged through wrecks, the railroads rebuild them. With railroads themselves these things balance each other; not so the car lines—they have no road and take none of the chances of operating.

Knowing that high braking efficiency means safety, but entails wear of brakes, wheels, etc., the cars of many car lines will be found equipped with air brakes, but with brake power much reduced to save wear. We might add, parenthetically, that no worse offender in this line can be found than the Pullman Palace Car Co. The car line is willing for the railroad to wear out its own cars in stopping theirs—if anything happens, it's the railroad that foots the bill.

The only way a railroad can make anything by hauling private line cars is to charge a mileage rate for loaded and another rate for empty cars, instead of paying mileage on the cars. Aside from their convenience to the owners, the private cars are a good investment; they make money by letting the roads use them.

The best emancipation proclamation the railroads of America could possibly make would be a united declaration that they would haul no more private line cars after a certain date, but they would pro rate the "line" equipment of the country and buy it in at a fair appraised valuation. An exception might be made in some cases, but we think not. If it would be an advantage to the shipper and car owner, then let a rate be fixed for hauling "line" cars at so much per ton per mile, loaded or empty; then whatever business the road did for the line owner, there would be a profit in it (for the road).

Most of the experimental couplers and half-breed air brakes are to be found on "line" cars. Why? They are cheap. The railroad must bother with their maintenance and replace the whole thing if some experimental coupler, or brake beam, or what not, gives out and makes a pile up of cars.

It's a case of a strong man helplessly holding up his hands to be robbed by a boy, and philosophically quieting himself with the thought that perhaps the boy may be a distant relative of his own wife.

What is wanted is a few honest railroad managers to look at this thing from the *railroads'* standpoint, collect figures that show just how the life-blood of the railroads is being sucked for the benefit of these gypsies of the road, and ask for a remedy.

Directors who will direct are already in sight, and it is not beyond the hope of men that the time is coming when railroad managers will accept the care of great transportation properties with the idea and purpose of building them up, and not with the sole thought of looting them; of organizing inside suckers that are advertised to the world as feeders; of *not* getting the most for the present, but of building up for all time.

When the light of day falls on this private car line business, all honest railroad men will stand for its discontinuance, and when their business is diverted into the proper channels, the railroads will be found to have gained wonderfully in their freight earnings. Why not kick this tribute levier off the door-step?

A Smart Alick politician in San Francisco had President Huntington, of the Southern Pacific, arrested for violating the Interstate Commerce Law, by granting a pass to the man who brought the charge. When the case came into court it was dismissed, because no proof was given that the pass had been used. The violation of the law is not in granting passes, but in permitting them to be used. We are afraid that other politicians on the Pacific Coast, where anti-railroad sentiment is a craze for revenue only, will not be made happy over this attack on Mr. Huntington. If there is anything which the average State politician hates worse than scarcity of boodle, it is interference with the free railroad pass. If the president of the Southern Pacific wanted an excuse for refusing passes to politicians, there will be blistered hoofs among that part of the fraternity who need to travel.

In talking about the new cars and locomotives recently ordered by the Southern Railway, Mr. W. H. Baldwin, vice-president of the company, remarked that they were not in need of the new equipment at present, but it would be required before the year was ended. He added that the company had taken advantage of the low prices to purchase their rolling stock now. This is certainly good policy on the part of the railroad company, and it has helped to keep several manufacturing establishments from shutting down. It is a pity that more railroad managers cannot see their way clear to order rolling stock now before the rush of orders begins to strike the car and locomotive builders. Those who come in late will have to pay, in higher prices and in delayed delivery.

See that your June paper contains the Car Chart; you are entitled to it.

BOOK REVIEWS.

GARDENIER'S READY HELP FOR LOCOMOTIVE ENGINEERS. By Norman Gardenier. Published by Edward Meeks, Philadelphia. Price $1.

This little book is one of the many now extant in the shape of questions and answers. The 596 questions are all in the front of the book, the answers in the back. The author does not claim originality in the questions, but some of them are original, and we fear not all as correct as they might be. For instance, Question 2, "How does a locomotive get her steam?" is answered, "By opening the throttle." Which, while in a sense true, is something like the reply of the bright boy who, when asked by a thoughtful uncle "I wonder who made that silver dollar?" answered promptly, "Daddy did." Question 18, "What should be the condition of (water) supply when about to descend (a grade)?" is answered, "Should have enough water to cover front end of flues after pitching over"—this is assuming that the engine is backing up. Question 21 asks: "Is it good policy to fire while injectors are on?" and the answer is, "It is not." Strange advice, this.

Question 43 asks: "How can the injector be started when the water in boiler is below the delivery pipe?" is answered: "Injector cannot be started in such a case, steam will not work against steam." We wonder how seriously this would be taken by men running engines where the checks go into the domes on the top of the boiler—there are several roads running such arrangements. Question 53: "Will an injector work if not enough steam to condense the supply of water?" Answer: "It will not." That it is necessary to supply a large amount of steam to *condense the water* will be news to the injector makers. Question 78: "What is expansion of steam?" Answer: "Allowing a given quantity of steam to *spread*"—this is one of the original answers.

Question 122: "If you found the steam pressure rising rapidly, would it be good policy to open the safety valve to relieve it, and why?" Answer: "No; as the violent rush of gases to escape, which would be mixed through the body of the water in the form of small bubbles, would be liable to cause the boiler to explode."

Great Scott! This is enough; the whole book bristles with evidence that the author knows a whole lot of things that are not so. To be sure, there are lots of questions answered correctly, but on almost every page there are mistakes and blunders enough to condemn the work as a bad one to put in the hands of enginemen for the purpose of instructing them.

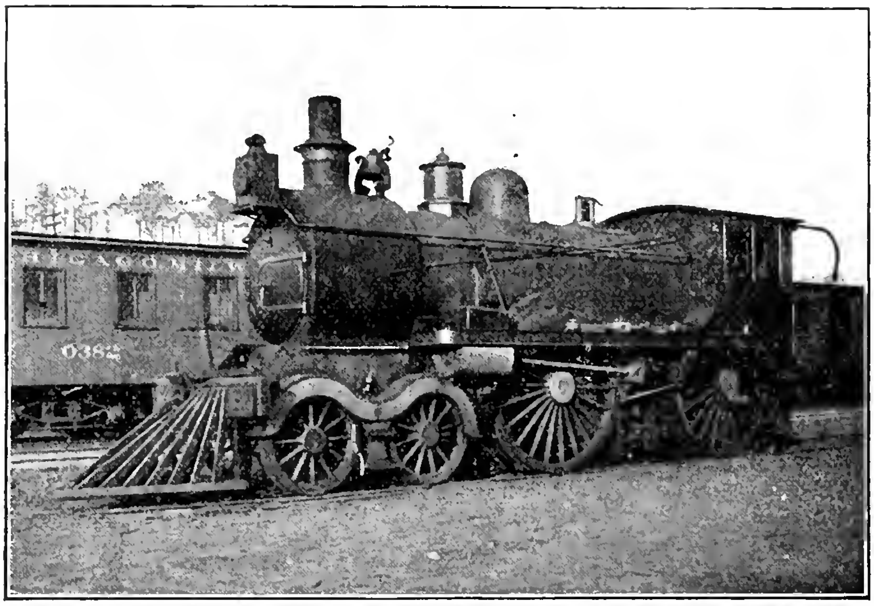
THE MECHANICAL ENGINEER'S POCKET BOOK. A Reference Book of Rules, Tables, Data and Formulæ for the Use of Engineers, Mechanics and Students. By William Kent, A M., M. E. John Wiley & Sons, New York. Price $5.

This is the latest and the best pocket book we have seen. It is bound in soft leather, with flap, same as Haswell, Trautwein and other similar works. The author, a well-known engineer and mathematician, has carefully verified every rule and table used, brought the whole work up to date and covered the field much more completely than his predecessors. The amount of time and labor on such a work as this can scarcely be estimated, and much credit is due any man who will devote several years of his life to such a work. Every mechanic should own such a book. It will save him hours of figuring, keep him straight on many points, and has the advantage of being truly reliable. Mr. Kent has been careful to give credit to his sources of information, and cites his authorities in all cases, which is often a guide to the student as indicating where more complete and detailed information can be found on a given subject. We cannot commend this work too highly.

The "James Toleman"—After the Ball.

One of the engines attracting much attention at the World's Fair was the "James Toleman." She was an untried experiment, having four cylinders, each pair coupled to a pair of 90-inch driving wheels; her boiler was flattened to get it between the wheels.

The engine was designed by a Mr. Winby, who had no other locomotive experience. She was built of the best material and the best English workmanship, no expense being spared to make her a great success.



THE "TOLEMAN" ENGINE—AFTER THE BALL.

Mr. Winby wanted her to haul fast, heavy American trains, and, after the Fair, she was put on the C., M. & St. P. road, between Chicago and Milwaukee, where they would like to haul ten sleepers on the division, 82 miles, in two hours.

She was quite English, ye know; so they put an old pilot, and a small headlight on her. She slipped, and then they borrowed a second-hand sandbox for her. The laws required a bell, and an old-time one was fished up from the scrap. She didn't "suck her ashes"—as the fireman explained—and an extension was put on her stack.

The side stays in her boiler developed more leaks and more kinds of leaks than were comfortable; the machinery broke down; she failed to steam all the time, or to get anywhere when she did steam, and both her friends and her foes voted unanimously that she wouldn't do.

For nearly a year she has been quietly resting (and rusting) on a stub track at the Milwaukee shops, just as she appears in our picture. If anyone wants an odd engine at little cost, the owner of this one would probably sell her dirt cheap.

Common Civility.

Walking around the shop with a master mechanic recently, the writer could not help noticing the gruff, surly and insulting tone of his remarks and orders to his men.

He ignored foremen altogether, and gave orders direct to everybody he met. We might add that the place looked more like a boar's nest than a shop. His bullying bluster made us think of the reply of the mate of a whaler who was offered "promotion, honorable mention and a share of the profits." "I don't want no promotion; I don't want no honorable mention; I don't want no share in the profits. All I want is common civility, and that of the darndest commonest kind."

A "darn common" kind of civility goes a long way with men—and it pays to use it.

Some of the railroad companies are experimenting with grease for lubrication instead of oil, which is so troublesome to keep in the boxes. We have heard of a grease which has been put on the market, which will not burn when in contact with red-hot iron; water will not wash it off, steam at eighty pounds pressure will not remove it; it will not overflow in filling, and is of such tenacity that it will not shake down from the fibers of the waste in the boxes, and of such lubricating efficiency that 50,000 miles have been run with one packing, covering more than one year in time.

New Advertisements This Month.

Laborers' Instruction Publishing Co. have an interesting announcement.

Henry L. Smith, Receiver, offers a valuable manufacturing property for sale, cheap.

The Ohio Injector Co. have a card appealing to the practical railroad men in a "telling way."

The Sams Automatic Coupler Co., of Denver, Col., score a point in their half-page advertisement.

The Rand Drill Co. describe their Air Compressors, adapted for railroad use, in a brief reading notice.

The National Malleable Castings Co. have an extra quarter-page announcement of the Tower Coupler.

The Baldwin Locomotive Works have a special half-page advertisement, showing several types of Locomotives.

The Schenectady Locomotive Works have an extra half-page advertisement, showing "one of their latest."

The Richmond Locomotive Works have a special page advertisement, showing their new Compound Locomotive.

Long & Alstatter, of Hamilton, Ohio, show one of their heavy Railroad Shop Punches in a half-page advertisement.

The Janney Coupler manufacturers—the McConway & Torley Co.—have a page announcement in this Convention number.

The Morden Frog and Crossing Co., of Chicago, show some of their improved product, reduced from working drawings.

The Safety Car Heating & Lighting Co., of New York, have an attractive page advertisement, showing their Pintsch Gas Lighting.

The Hinson Mfg. Co. present some interesting facts concerning their Couplers, which will appeal to practical railroad men.

The International Correspondence Schools, of Scranton, Pa., have a half-page display relative to their Correspondence Schools.

The Smillie Coupler Co. have a new card in this issue of LOCOMOTIVE ENGINEERING. They are making a fine Tender Coupler.

Pedrick & Ayer Co. have a page announcement of their Special Tools for railroad repair shops, air hoists and compressors.

Samuel Hall's Son, of New York, present a half-page announcement of their Wrenches, for which many valuable features are claimed.

The Central Park Hotel, Alexandria Bay, N. Y., has a quarter-page announcement of their superior accommodations—plenty of room for all who come.

The Scientific Machinist has a card on another page of this issue, soliciting correspondence with the readers of LOCOMOTIVE ENGINEERING.

The Daugherty Typewriter Co. claim "everything in sight." See their advertisement on another page—it appeals especially to railroad men.

B. M. Jones & Co. have a half-page announcement of "Taylor Best Yorkshire Stay-bolt Iron," and "R. Mushet's Special and Titanic Steel" products.

The Gold Car Heating Co., corner Frankfort and Cliff streets, New York, have an interesting page advertisement, relative to their system of Car Heating.

The Smith Exhaust Pipe Co., whose device is being adopted on many of the trunk lines, have a page announcement, containing some valuable points.

Mr. Daniel M. Brady, president of the Brady Metal Co., is said to hold the "blue ribbon" record for attending conventions. This is his twenty-third meeting.

George Place Machine Co., who make a specialty of equipping railroad repair and machine shops, make an announcement of a list of bargains in Machine Tools.

The Sterlingworth Railroad Supply Co., No. 256 Broadway, New York, have a handsome page advertisement, showing three varieties of Brake Beams they are pushing.

The Nicholson File Co., the oldest and largest file concern, operating three distinct plants, have a card on another page. Railroad mechanics know the quality of this company's product.

G. L. Stuebner & Co. have an advertisement of Steel Tubs for coaling locomotives and other purposes, and have an interesting pamphlet describing some new designs for railroad use.

Maris Bros. (formerly known under the firm name of Maris & Beckley), of Philadelphia, manufacturers of Cranes and Hoists, call attention to their work in a quarter-page advertisement.

The Williams Typewriter Co. make an announcement in their half-page advertisement, which will interest railroad and supply men who will have correspondence to attend to at the Convention.

One of the most striking advertisements this month is that of the Utica Steam Gage Co., showing a night scene "on the rail." There is an interesting article on the Utica Gages in one of the reading columns.

The Garden City Sand Co., of Chicago, Ill., advertise their line of Fire Brick for all railroad purposes. They have prepared an interesting catalogue, showing illustrations of their product used for fireboxes, etc.

The Gould Coupler Co. are well represented in this issue of LOCOMOTIVE ENGINEERING, both in their page advertisement and the Car Chart Supplement, which shows the Gould Vestibule, Platform and Coupler.

S. N. Clarkson & Co., 126 State street, Chicago, have a new and handsomely illustrated catalogue they desire to send every railroad man who wants a reliable watch. They make a specialty of Railroad Watches.

Joseph Dixon Crucible Co., of Jersey City, N. J., are good advertisers, because they have a good thing and believe in "pushing it along." Their Lubricating Graphite is used extensively by railroad companies.

The A. E. Filley Mfg. Co. have a half-page design and announcement of their "Defiance" brand of Car Roofing—something new and destined to be a good "seller." Mr. Jones will be in attendance at the Convention.

That famous "Book of Tools," compiled and edited by Charles A. Strelinger & Co., Detroit, Mich., at the expense of thousands of dollars and years of patient labor, is announced to be given away, in an artistic page advertisement.

The Baker Heater is well presented in a page advertisement, containing a summary of the claims of its inventor, William C. Baker, who will this year be represented at the Convention by Miss Dean, his able secretary and office manager.

The Thousand Island House is graphically portrayed and described in a page advertisement, by Mr. J. B. Wistar, the genial Boniface, who will welcome the railroad men and take good care of them during the coming Conventions.

Many inventors and owners of railroad patents, who want working models, are referred to the card of William Gardam & Sons, 98 John street, New York, who are specialists, and supply everything in this line at short notice, and at a reasonable price.

The Tyler Tube & Pipe Co. "show up" something which should especially interest master mechanics; and if the readers cannot guess what the cuts mean—and want to know—Mr. Tyler and Mr. Molleson will be glad to explain at Convention, or by mail.

The Ingersoll-Sergeant Rock Drill Co., 26 Cortlandt street, New York, are about to issue a very interesting new work on the subject of "Compressed Air," which will interest railroad mechanical men. Readers of LOCOMOTIVE ENGINEERING who apply will be furnished a copy of this new book.

Bogue & Mills Mfg. Co. have a half-page announcement of their Pneumatic Street and Crossing Guards. This is the crossing guard which received the award for "simplicity of design and ingenious arrangement for locking gates in raised or lowered position, and interlocking them at railroad crossings," at the World's Columbian Exposition.

The National Machinery Co., of Tiffin, O., who have an attractive page advertisement, are among the solid concerns who have made a long study of the requirements of the modern master mechanic and shop foreman. They have a well illus-

rated standard size catalogue for free distribution, showing their full line of tools.

The Standard Paint Co., No. 2 Liberty street, New York, one of the oldest and strongest concerns in the country in the line of paints, papers, car roofing, etc., are represented in this issue by a page advertisement of their "P. & B." brand Car Roofing, and will be personally represented at the Convention by Mr. Frank S. De Ronde, sales manager.

The Whiting Foundry Equipment Co., who have a half-page announcement, is one of the progressive Foundry Supply and Crane concerns who are pushing the use of compressed air in shops, foundries, etc. The half-tone cut in the advertisement shows one of the latest devices of the company. Mr. J. H. Whiting is president of the company, and is up to date on labor-saving devices for railroad shops.

The Brown Hoisting & Conveying Machine Co., who recently added to their already large Crane business, have a half-page announcement of their complete assortment of devices for economically handling all sorts of materials, unloading cars, etc. The sales department of this large company has recently been extended by the opening of offices in New York, Pittsburgh, and Chicago. Mr. W. A. Stadelman, manager New York office, will attend the Convention.

The Page Woven Wire Fence Co., Adrian, Mich., are having good success with their railroad fencing, and have recently added several new machines to their factory to meet the increasing demand. The Lake Shore & Michigan Southern Ry. have adopted the Page fence as their standard, and other roads are beginning to use it. The Page Company have just issued their new catalogue, containing some fine illustrations, showing their fence in different locations along the Lake Shore road.

The Kalamazoo Railroad Velocipede & Car Co. recently shipped to Guatemala a mixed carload of hand and velocipede cars. They also made shipments of velocipede cars to Zurich, Switzerland, and Moscow, Russia. The Choctaw, Oklahoma & Gulf Railroad has just received one of their improved steam inspection cars.

In looking around the pattern makers' shop of railroad works, lately, we were much interested in the ingenious performance of a workman, who was converting the pattern of a 17 x 24-inch engine into a 19-inch size. The thing might turn out all right, but we reflected that the ports of the 17-inch cylinder must have been very large if they were going to be suitable for the larger cylinder. On general principles we would say that it would pay to make an entirely new pattern when an increase of size to this extent was called for.

Moving Factories Out of Cities.

One of the most common things heard during the hard times, that are not far behind us yet, has been threats made by manufacturing concerns to move away from large cities and establish their works in the country. There is, in fact, a chronic inclination to move away from the regions of heavy taxes and labor combinations to places where power is cheap, taxes are low and the walking delegate unknown. Those who make this move generally find that they meet with evils in the new surroundings which are as hard to bear as those from which they had fled. Some amusing remarks made by "Chordal" on this subject are worthy of serious notice. When the last epidemic of "moving into rural districts" was on, he wrote:

"When a man moves from a metropolis off to Smith's side track, a thousand miles from anywhere and away beyond the jumping-off place, he will find that he makes a mistake, unless he is engaged in a business which does not require contact between producer and consumer. Customers don't know where the place is; don't know how to get there; haven't time to go there, and don't want to go there, anyhow. Special friends will take the short cut and buy elsewhere. If a man is engaged in making things worth over a hundred dollars apiece, he had better 'stay around' if he wants to sell them. If a machine builder is unfortunate enough to find himself off somewhere where his customers can't and won't get at him, he must, of necessity, find some way to get at his customers. He finds, by fine calculation, that by going to a tank station to start business he saved thirty-five hundred dollars a year, and now he finds he must incur an expense of about five thousand dollars per year on account of extra 'traveling and advertising.'

"No matter where a man hangs his shingle, he must travel and advertise, of course. If ten customers run up against his premises accidentally, he can bring ninety more by a judicious investment in printer's ink and railroad tickets. If he lives in the woods he must sell every cent's worth by appeal.

"Suppose I take a notion to envy the man who is situated among the hills, with a coal mine in his front yard and a neighbor's iron pile handy. Suppose I manufacture wood-working machinery, and suppose I sit down and figure up how much I can save on power, fuel and material in a year. Suppose these figures show a tip-top income in themselves, should I pack up and move into this district myself? Would I make any money by it? Would I lose any by it? As a builder of machinery, I would find it necessary to confer with at least one-third of my customers. They want to see what they are going to buy; they want to see the shop, and they want to see me. I travel around, and find men have bought of others, when the order would naturally have come to me. On inquiry and protest I am told that 'We didn't have time to go away up there. We can't step out of the business world to buy things,' etc., etc.

"Manufacturing economies may sometimes be purchased at the expense of business. Go where orders can be filled cheaply, and the orders won't come—not always, of course, but often. A man who wants to buy a $300 machine is willing to go into a certain district and investigate, but he is unwilling and unable to go all over the country, or into inaccessible neighborhoods."

An Engineer's Experience with Graphite.

"My experience with Dixon's Ticonderoga Flake Graphite has been very satisfactory. In one case my crank pin got so hot before I knew it that it melted the babbitt all out of the brass and closed the oil hole up. I cooled the pin, and filled the oil cup about two-thirds full of oil, and then put enough graphite in to fill the cup; after that I was able to bring the engine to the Philadelphia shops, a distance of 25 miles, without the pin getting dangerously hot. Without the graphite, I think it would have given me trouble, as the pin was cut very bad and new brasses had to be put on. I gave a sample of the graphite to an engineer on our division to try it, and he was so pleased with the result that he said he was going to get some for his own use. For my part, I always intend to have a little of this graphite on the engine with me. It seems strange that the master mechanics do not insist that the engineers shall carry it on their engines; for my part, I am sure the engineers would be glad to do so if the company would provide it, but they do not feel that they ought to be obliged to buy it for themselves when it is such a saving to the company's engines." The above is a sample of the many letters which the Dixon Crucible Company, of Jersey City, N. J., receive from engineers. Any engineer who would like to make a practical test of graphite, can receive a sample and an interesting pamphlet by addressing the Dixon Company.

The American Balance Slide Valve Co. have issued their annual catalogue, which contains excellent illustrations of their balanced valve and its various parts. The catalogue also contains interesting descriptive matter and testimonials as to the efficiency of the valve on railroads where it is in use.

The Great Northern road has the best equipped air-brake instruction room we know of, for a stationary plant, at its shops at St. Paul. A separate building is fitted up with full train equipment of both Westinghouse and New York brakes, with all the kinds of valves and other apparatus used on the system. This room is in charge of Mr. M. E. McKee, the air-brake inspector of the system.

PERSONAL.

Mr. Luther Cameron has been appointed road foreman of engines of the Cumberland Valley.

Mr. Jesse Waters has been appointed superintendent of the Midland Terminal, with headquarters at Gillette, Col.

Mr. Robert Stewart has been appointed chief car inspector of the Philadelphia & Reading, with headquarters at Reading, Pa

Mr. W. L. Cameron was appointed road foreman of engines, May 1st, of the Cumberland Valley Railroad, with headquarters at Chambersburg, Pa.

Mr. H. M. Burgand has been appointed purchasing agent of the Western Maryland Railroad. He was formerly local ticket agent of the road at Baltimore.

When T. B. Purves, Jr., left the Boston division of the B. & A. to take charge at Springfield, the roadmen presented him with a handsome silver service.

Mr. B. E. McIntyre has been appointed purchasing agent of the Mexican Central, with headquarters at Boston, Mass., to succeed Mr. E. W. Baker, resigned.

Mr. H. M. Missimer has been appointed master mechanic of the Lehigh & Hudson River, with headquarters at Warwick, N.Y., to succeed Mr. Stott Mills, resigned.

Mr. W. L. Wallace has been appointed superintendent of motive power, machinery and rolling stock of the Santa Fé, Prescott & Phœnix, with headquarters at Prescott, Ariz.

Mr. Henry Watkeys has been appointed master mechanic of the Louisville, New Albany & Chicago, a position which he held several years ago. Headquarters, New Albany, Ind.

Mr. J. H. Agnew, who was for some years master mechanic and then superintendent of the South Carolina Railroad, has established a roofing company in Findlay, O., and is doing well.

Mr. J. T. McBride has resigned as general manager of the Everett & Monte Cristo to accept the position of vice-president and treasurer of the Duluth, Missabe & Northern, with headquarters at Duluth, Minn.

Mr. E. St. John, vice-president of the Seaboard Air Line, was recently presented with a handsome gold watch by the locomotive engineers of the Chicago, Rock Island & Pacific, of which he was formerly general manager.

Mr. J. B. Crooker, vice-president of the Everett & Monte Cristo, has been appointed general manager of that road in addition to his former duties, to succeed Mr. J. T. McBride, resigned. Headquarters, Everett, Wash.

Mr. Charles E. Walker, superintendent of motive power of the Toledo, St. Louis & Kansas City, with headquarters at Frankfort, Ind., has tendered his resignation, to take effect June 1, to accept a position on a Southern road.

Mr. A. J. Schevers, who has for nearly ten years represented the American Brake Co. in Chicago, has left that position to be representative of the McConway & Torley Co., for the Northwest. His office is in the Grand Pacific Hotel, Chicago.

J. J. Leighton, the Wisconsin Central engineer who maintained a hotel register at the World's Fair, has gone into the artificial limb business at St. Paul. His concern have something new in an air-cushion stop for the socket of artificial limbs.

Mr. G. R. Henderson, mechanical engineer of the Norfolk & Western, at Roanoke, Va., has gone to Europe to be absent two months. He is going to spend the greater part of the time examining the railroad machinery in Great Britain and France.

An examination of the physical condition of the Chicago, Burlington & Quincy Railroad property was made last month by Mr. S. M. Felton, president of the Queen & Crescent, and by Mr. C. H. Hudson, chief engineer of the Southern Railway. The work was done by request of the board of directors.

Mr. E. L. James, the popular secretary of the New England Railroad Club, who has been chief clerk of the motive power department of the B. & A. for the past fourteen years, has been made secretary to the general manager. James is a good fellow and a gentleman, and the B. & A. men are pleased at his promotion.

Mr. A. W. Greenwood, master mechanic of the East Broad Top Railroad & Coal Company, has been appointed acting superintendent, and will perform the duties of both offices. Mr. Greenwood is a graduate of the Pennsylvania Railroad, having served his machinist apprenticeship in the Altoona shops. He rose on that road to be assistant master mechanic.

One of the many warm friends of LOCOMOTIVE ENGINEERING in the Northwest is Mr. Chas. Stearns, master mechanic of the Chicago & Northwestern, at Fond du Lac, Wis. Mr. Stearns was for years chief of the Fond du Lac division of the Brotherhood of Locomotive Engineers, and he is still as popular among the boys as he was when they elected him chief.

Mr. Howard A. Pedrick, inventor of the excellent belted air compressor, built by the Pedrick & Ayer Co. (of which concern he is general foreman), recently delivered a lecture on the Uses of Compressed Air, before the Foundrymen's Association, at their recent meeting in Philadelphia, Pa., on April 3d. It was voted around the meeting, quietly, that the young man knew what he was talking about.

Mr. George F. Gardner has been appointed superintendent of the Pittsburgh and Clearfield & Mahoning divisions of the Buffalo, Rochester & Pittsburgh, with headquarters at Bradford, Pa., in place of Mr. James Bruce. Mr. Gardner has been superintendent of the Pittsburgh, Akron & Western for some time past, and formerly for nearly five years was superintendent of the Zanesville & Ohio River, and afterwards for a few months general superintendent of the Cincinnati, Lebanon & Northern.

Mr. W. W. Rickard has been appointed foreman of machinery of the Senora Railroad, at Guaymas, Mex. Mr. Rickard is a graduate of the Burlington Cedar Rapids and Northern shops at Cedar Rapids, where he learned the machinist trade, and where his father is a leading hand in the car department. If he turns out as good a foreman as he was a machinist, his employers have secured a first-class man. He worked occasionally for the writer, and was a young man who did faithful work when the boss was absent.

Mr. W. S. Martin, superintendent of the O. & N. at Russellville, Ky., was recently appointed superintendent of the L. & N., at Louisville. He was a popular and much loved officer of the O. & N., and the boys got out a list and proposed to give him a present that would make him remember them, but Mr. Martin got wind of the affair, and wrote them a letter requesting them to drop the matter once and for all, as he asked only their respect and would accept no presents. It is safe to say that the O. & N. men esteem him much more now than if he had accepted a costly present from them.

During a recent visit to Mr. E. F. C. Davis, formerly general manager of the Richmond Locomotive Works, and now with the C. W. Hunt Co., New York, we enjoyed the privilege of examining a wonderfully ingenious planimeter, invented by Mr. Edward J. Willis, superintendent of Talbot & Son Co. Works, Richmond, Va. The instrument is a complete calculator of everything that has generally to be computed in indicator cards or of anything that requires superficial measurement. It gives measurement of areas in square inches, feet or yards; it shows the mean effective pressure of an indicator diagram, and also the horse power, without any outside calculation whatever. The instrument will be a great convenience to men who require to take and figure up many indicator diagrams.

Mr. Eckley B. Coxe, formerly president of the Delaware, Susquehanna & Schuylkill Railroad, died suddenly at Drifton, Pa., last month. He was born at Philadelphia, in 1839, and was educated at the University of Pennsylvania. Then he went to Europe, and studied engineering for several years. On returning to this country he began, with his brothers, the mining of anthracite coal in the Lehigh region. His practical and scientific knowledge of mining gave him a reputation throughout the United States. He was a member of the American Institute of Mining Engineers, the Institute of Mechanical Engineers, and the American Society of Coal Engineers. In 1872, he published a translation of Weisbach's "Mechanics of Engineering and Construction of Machines."

Mr. P. M. Arthur, grand chief of the Brotherhood of Locomotive Engineers, sailed from New York last month on the steamer *New York* for Liverpool. He has gone to Scotland, to visit the scenes of his boyhood after an absence of forty years. He was granted leave of absence for six months at last convention of the Brotherhood, and he intends spending the whole time abroad. On the morning the steamer sailed there was a large delegation of locomotive engineers, their wives and other friends on board, wishing the grand chief a pleasant journey and safe return. One of the saloons was loaded with magnificent offerings of fruit and flowers. One bouquet was made up in the form of a locomotive, which excited much admiration. Few travelers have gone abroad with such a cordial send-off as Mr. Arthur received.

Mr. A. M. Wellington, editor and proprietor of the *Engineering News*, and one of the most celebrated civil engineers in the country, died in New York last month. Mr. Wellington was a New England man by birth, and learned the elements of his profession in an engineer's office in Boston. About twenty years of his life were spent in active engineering work, the greater part of it having been on railroads. He was chief engineer of the Mexican Central for a time, and spent about five years on different railroads in Mexico. As a result of his wide experience in railway location, he published in 1887 a treatise on the subject, which soon attained a wide popularity. In 1885 he turned his attention to technical journalism, and after two years' service as an editor of *The Railroad Gazette*, he became, in 1887, one of the editors-in-chief and proprietors of *The Engineering News*. The rest of his life was spent in this work, interrupted only by his service as consulting engineer to various enterprises. He published his first work, "The Computation of Earthwork from Diagrams," when only twenty-four years old, and the first edition of his most important work, "The Economic Theory of Railway Location," was written at the age of twenty-seven. In 1887, he published a revised and very much enlarged edition of this work, and it soon became the standard treatise on that subject. He was also the author of various minor technical books. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Canadian Society of Civil Engineers, and the Engineers' Club of New York City. He contributed many important papers to the published transactions of these societies, and was widely quoted as an authority.

Saved by Knowing How to Set Valves.

"Of all places in the world to work in," remarked the White Headed Engineer, "give me the United States. I have tried all the Central American and South American States, where there are any railroads to speak of, and I would rather work for small pay at home than earn big money in any of these countries. So far as enjoying the comforts and pleasures of life, one might as well be in State's prison. In most of the Southern countries one has to live in very uncomfortable boarding houses or hotels, and the sanitary arrangements are miserable. Then, if you get into any dispute, justice is a factor that is certain to be on the other side.

"I met with a sad example of this about fifteen years ago in Nicaragua. I had gone out to run an engine on the Greytown & Castillo Railroad, and I found after I went there that there was no engine ready for me, so they set me to work in the engineers' corps. One evening I went out to see the sights, which were very few in Castillo, and through what I afterwards heard was a case of mistaken identity, a native forced a quarrel upon me, and I had to knock him down in self-defence. The place was in an uproar in an instant, and I was overpowered and dragged to a dirty jail.

The 10th Day of May, 1895, on the Black Hills (Narrow Gage) Line of the F., E. & M. V. Road.

"In the morning I tried to send for the American Consul, but it seemed impossible to reach that official, if he existed, and I languished for weeks in jail without a trial. I had spent all the money I had, bribing my jailors to interest someone in my case, and had become hopeless of ever getting back to freedom again.

"One morning, as I was lying in my cell, groaning over the misfortunes that had overtaken me, a man was ushered inside, and asked if I knew how to set valves. 'Certainly I could,' was the reply, 'have you any valves to set here?'

"'No,' said my visitor, 'not just here; but further up the river, we have a job of that kind. If you can do the job for us, we will get you released from jail, and will pay you $100 in gold.'

"Two hours afterwards I was free and on my way up the river with my new acquaintance, who was owner of a small steamer brought out from England.

"It appeared that the men who put the machinery together did not know how to set the valves of a link-motion engine, and the boat had lain for weeks unable to move, because those who had tried had failed in setting the valves. The owner was thinking of sending to Managua, the capital city, for a man to set the valves of his engine, when he heard that an American engineer was in the jail at Castillo.

"I set the valves without any difficulty, and worked as chief engineer on the boat for two years. Then I came home, and I find the United States good enough for me."

A correspondent in Murphysboro, Ill., sends us the following account of an extraordinary accident: Engine No. 1, in charge of Robert Kelley, was running along at a speed of twenty-five miles an hour, when the left back driving wheel broke off, and was immediately followed by the breaking of the left main rod and right back drivers. The most peculiar part of the accident was that the left main driver and right back drivers never left the rail. The left back jumped off the rail, ran about two rail lengths, and then jumped back on the rail again before getting stopped. The engine ran over two small trestles and did not go into the ditch, and not a wheel on the train left the rails. The engine was a common eight-wheeler and about eighteen years old.

The Sterlingworth Railway Supply Co. have been vigorously pushing the sale of their specialties, and, as a result, they have placed their brake beams and steel body bolsters on the following roads: Toledo, St. Louis & Terre Haute; Burlington, Cedar Rapids & Northern; Delaware, Lackawana & Western; Central R.R. of Georgia; Maine Central; New York, Ontario & Western; Mather Stock Car Co.; Cold Blast Transportation Co.; Fall Brook; Fitchburg; Georgia Southern & Florida; Atlanta & West Point, etc. Their orders aggregate many thousands of beams and bolsters.

It is folly to build out wearing pieces and liners on driving boxes when they can be put on hubs. We recently saw some driving wheels with the hubs worn clear through into the core holes by this foolish policy. Turn out a recess in face of hub when they are comparatively new, and pour in block tin, or even good babbitt, and you will have a good bearing, always easy to renew, without doing machine work of any kind.

Mr. S. J. Poarch has been appointed general forman of the Atlantic & Danville shops at Berkley, Va. He was formerly with the Norfolk & Southern.

General John B. Gray, of the American Brake Co., with his wife and daughter, sails for Europe on June 29th.

EQUIPMENT NOTES.

The B. & M. order for 600 cars still hangs fire.

The C., O. & Gulf are in the market for 200 cars.

The Texas Pacific are asking bids on 300 box cars.

The Philadelphia & Reading have ordered 1,000 cars.

Jackson & Woodin got the Fitchburg order for freight cars.

The Adamson Poultry Car Co. are in the market for some cars.

The Col., Hock. Valley & Toledo have given an order for 900 gondola cars.

The Montana Coal Co. have ordered 200 coal cars from the South Baltimore Car Co.

The Boston & Maine have ordered six ten-wheelers from the Manchester Works.

The San Francisco & San Joaquin Valley are asking bids on three 19-inch ten-wheelers.

The Big 4 have given an order to the Indianapolis Car and Foundry Co. for 300 stock cars.

The Baldwin Locomotive Works have orders for four of their four-cylinder compounds for Chili.

The Dickson Locomotive Works, at Scranton, are building some heavy, fast passenger engines for the D. & H.

The Rogers Locomotive Co. have an order from the Government of Chili for four two-cylinder compound locomotives.

One thousand box and 300 refrigerator cars for the Illinois Central went to Haskell & Barker, of Michigan City, Ind.

The M., K. & T.'s order for engines was divided between Baldwin, Richmond and Brooks. They will soon order ten more.

The Louisville & Nashville have placed orders for 950 cars. The Mt. Vernon people have got 250 box cars and 400 gondolas, and the Elliot Car Co. have got 250 box and 50 ore cars.

Baldwin and Schenectady have each received an order from the Concord & Montreal for one locomotive. The intention is to put the engines in competition, and thereby decide on which style of engine is best adapted for the service of the road.

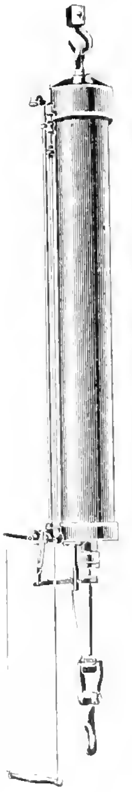
"Printers' Ink" Says:

"Of the eighteen publications devoted to the interests of railroads, LOCOMOTIVE ENGINEERING, a monthly published at New York, N. Y., is credited with a circulation rating six times as great as that accorded to any other."—*Printers' Ink*, May 15th.

Printers' Ink is a well-known advertisers' paper, the organ of the Geo. P. Rowell Agency and the American Newspaper Directory, of this city. They have investigated our circulation, and offer a reward of $100 to anyone who will disprove our claims. This is entirely unsolicited on our part. We pay *Printers' Ink* nothing for advertising, do not subscribe for it, nor have we ever even bought a directory from Rowell.

The cold, naked truth of the matter is that the great paid subscription list of LOCOMOTIVE ENGINEERING is making itself felt, and honest men, far and near, are acknowledging its influence—whether they like to or not. We very seldom use our reading columns to blow our own horn—the advertising pages are the proper place for that, both for ourselves and other advertisers—but we feel that our readers will forgive us for just this one little toot.

Improved Air Hoist.



The air hoist shown in the annexed engraving has been put upon the market by the Whiting Foundry Equipment Co., Chicago. It is fitted with

An adjustable speed valve, with safety check and self-oiling device.

An automatic shut-off, stopping the load at any point desired.

An improved exhaust attachment, preventing the dust of the shop or surrounding atmosphere from entering the cylinder.

A safety air cushion for piston, swiveled and swinging hook, and a specially constructed deep piston.

The cylinder is made of extra thick welded steel, accurately bored and polished inside. The material and workmanship are first-class throughout.

The Mechanical Conventions.

The programme of work laid out to be done by the master car builders and the master mechanics at their Conventions next month, would seem to promise busy and profitable meetings. The Master Car Builders' Association will have reports on ten subjects—all of them live ones—that are certain to excite considerable discussion. The first subject to come up is on car interchange; the committee being required to report on how cars in interchange may be maintained equitably to owners and operators, with least expense and detention. We think that the Barr plan of holding owners responsible for most of the defects will be adopted by a large majority. In that event there will be so few excuses left for detaining cars, that new rules for facilitating the movement of cars will not be necessary.

Two committees will report on brake shoes—one on road tests, the other on laboratory tests. There is so much diversity of opinion concerning the best mixtures of metal for brake shoes, that authoritative information on the subject is greatly needed. There is an impression among nearly all people intimately acquainted with brake matters, that a soft shoe holds much better than a hard one. It is to be hoped that the committee will be able to show exactly what the difference is. If the hard shoe holds much less than the soft one, the brake leverage ought to be adjusted to suit.

"Air-Brake Tests" will be reported on by one committee, and air-brake and hand-brake apparatus on cars by another. The latter committee will report on the standard levers, and all other questions of importance pertaining to the subject.

The old subject of "Car Lubrication" will again be reported on, and the committee is directed to consider the economics of journal bearings. The main difficulty about this question is that some railroad officers want the Master Car Builders' Association to inform them how to use cheap oil and cheap metal for bearings and obtain good results. It cannot be done.

One committee is going to report on what changes may be desirable in the standard size of the master car builders' automatic coupler shank, and to recommend a standard yoke or pocket strap for rear-end attachment to cars. This is a move to promote safety and efficiency. There is good reason for believing that the size of shank adopted, which was an inheritance from the link and pin type, is too weak for modern conditions. The breakage of this shank is a much more dangerous matter than it was with the small head of an old-style coupler.

Mounting new and second-hand wheels so that they shall be properly located upon the axle, is what may be regarded as a minor subject.

The next one is quite important, the committee being required to consider what improvements may be made in the construction of passenger car ends and platforms, for increased strength in ordinary service and in emergencies. The end is about the weakest part of an ordinary car, and there are special methods of construction in use on some roads that entirely overcome the weakness. If the committee will make these designs familiar to the members of the association, a good service will have been rendered.

The last report also relates to car design, the committee being required to report on the best methods of construction and staying of the sides of a 60,000 pounds capacity coal car with high sides.

The Master Mechanics' Association will wrestle with a most formidable list of reports—eleven in all. There are three subjects carried over from previous years, viz.: Exhaust Nozzles and Steam Passages, Locomotive Fire Kindlers, and Shop Tests of Locomotives. We understand that Mr. Quayle, chairman of the first committee, has been doing special experimental work which will make a valuable report. With all that has been done to find out the best propor-

tions of exhaust nozzles and steam passages, nothing definite has yet been settled. Locomotive fire kindling has made a little progress within the year, and it will be interesting to hear the experience of those who have banished the wood pile and resorted to oil. One of the disappointments in store for the Convention, is the fact that the Committee on Shop Tests of Locomotives have not succeeded in raising the money required to carry on the tests at Purdue University.

The committee appointed to confer with manufacturers and others, and to submit a practical system of gages for sheet metal, tubes and wire, for adoption by the association, have done work during the year which is likely to be of permanent benefit to railroad companies and manufacturers. They have worked with a committee on the same subject from the American Society of Mechanical Engineers, and there are good prospects of all the engineering societies in the country adopting a uniform system of measurement.

The subject of locomotive boilers—always a live one—is receiving the attention of three committees. Causes of bulging of flue sheets will be reported on by Mr. P. Leeds. If he can bring out facts which will help to remedy this disorder, he will confer a lasting benefit upon nearly all railroads. Best material for boiler tubes and specifications for same are under investigation by a committee, of which Mr. T. A. Lawes is chairman. Leaky tubes are the bane of some railroads, and the material used has close relation to the trouble. A standard specification for a first-class tube is greatly needed. Mr. A. E. Mitchell will report on riveted joints, and he is requested to submit a set of proportions representing the most approved practice. The thorough manner in which Mr. Mitchell has gone into the investigation of the subjects put under his charge in the past is assurance that his report will tell all the weakness and strength of current practice. With the increase of steam pressure, it is very desirable that the strongest form of riveted joint should be employed.

The remaining subjects are: "Utilization of Railroad Scrap Material," "Pistons and Piston-Rod Fastenings," "Wear of Driving-Wheel Tires," and "Transmission of Power"; all of these are of living interest and furnish the basis for good practical discussion.

The reports and discussions of these important subjects will bring out information which is certain to accrue to the benefit of railroad companies. The railroad companies which do not send their representatives to these meetings, neglect their own best interests.

The reports and discussions in the meetings reflect the most progressive ideas for improving railroad rolling stock, for promoting safety, and for keeping down expenses; but what is learned at the meetings is by no means the most valuable educational effect of the Conventions. The private discussions between man and man, the exchange of experience lessons among those working for the same end—by different methods, have an educational effect of much value. As the associations grow older, their value to the members appears to increase.

A Satisfactory Welding Compound.

Detroit Ground Crystal is a new welding compound by which solid welds, either lap or jump weld, can be made at separate heats on any grade of steel, from the lowest to .140 in carbon (Mushet excepted). It is claimed for this compound that it toughens and refines the steel, and that in making the weld, the compound so acts on the steel as to amalgamate the molecules so perfectly that no trace of the weld can be seen in the grain of the stock.

A test was recently made in Newell & Co.'s forge shop, in Detroit, on toughening and refining, which proved the compound had the full control of steel at any heat. A bar of black diamond steel was put in the fire and burned so that it dropped from the end. The burned end of the bar was then rolled in the compound while at white heat, the end upset and drawn down into a cold chisel. The chisel was ground and tempered in a bath made from the compound, and left at a straw color. Then the chisel was struck eighty-six blows with a sledge hammer, and driven three-eighths of an inch into a piece of wrought iron. The severe test failed to harm the chisel in any way. Afterwards the face end of the chisel was broken off for closer inspection. The grain of the steel appeared to be much finer than in the original bar, and no ill effects from the burning could be found.

It is also claimed by the owners of the compound that it is an absolute preventative for fire check in tempering, when used either in a bath or applied to the steel while hot. They also claim that in brazing, the compound does not swell like borax, and thus no pinholes are made. It likewise case-hardens steel. By use of the compound, steel can be worked as easily as iron, without danger of spoiling.

The manner of using Detroit Ground Crystal is so simple that any smith who understands taking a proper steel heat can use it successfully. One pound of the compound will do as much work as three or four pounds of borax. The necessary heat is a high borax heat. The compound will work equally as well in any oil, natural gas, clean hard coal fire, as in a close coke fire. No acid or anything injurious to steel is a part of the compound. On the contrary, it appears to redeem the steel and gives to it renewed life.

Practical tests of this compound have been made at all of the leading steel forges in Detroit. In all cases the tests proved satisfactory, and the compound has been adopted by most of them. Many well-known users of steel in the United States are testing the merits of Detroit Ground Crystal.

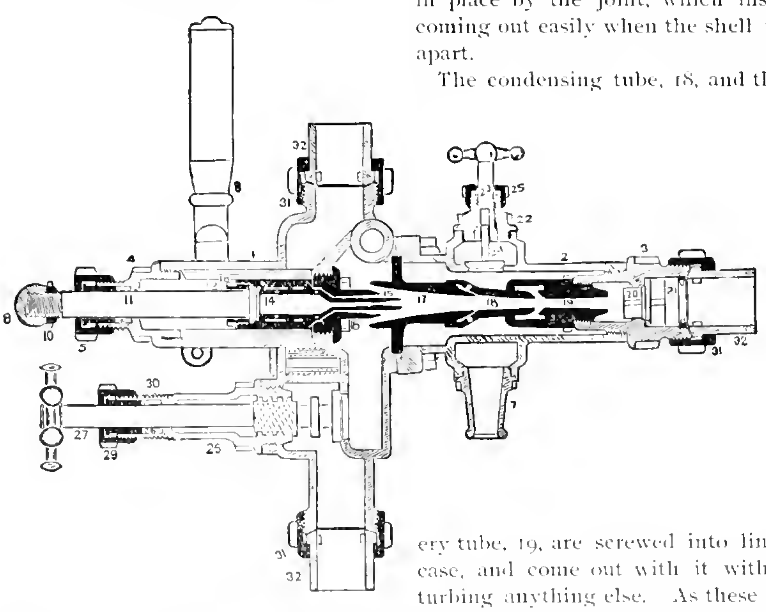
The compound was originally owned by the Newhall & Hicks Co., but Mr. Hicks, the inventor, has sold his interest in the business, and the firm is now known as E. G. Newhall & Co.

The Ohio Injector.

The sectional cut will serve to explain the details of this injector to our readers, all of whom are familiar with this kind of device.

The instrument conforms to the regular standards in sizes and connections. They are made with screw starting valve and lever valve, as shown in cut.

The body is made in two parts, bolted together; the intermediate tube, 17, is held in place by the joint, which insures its coming out easily when the shell is taken apart.



The condensing tube, 18, and the delivery tube, 19, are screwed into line check case, and come out with it without disturbing anything else. As these tubes require the most attention, this is an advantage in cleaning and renewing tubes.

The makers claim for this injector, simplicity in construction, easily taken apart for cleaning or renewal of parts, uses less steam and has greater range of delivery than other makes of injectors, works equally well in high or low pressure, and prompt and positive action under all circumstances.

They are made by the Ohio Injector Co., at Wadsworth, O., and sold by General Manager Frank W. Furry, at 1302 Monadnock Building, Chicago, Ill.

Answers to Traveling Engineer's Questions.

The following answers to the "Traveling Engineer's Form of Examination for Firemen for Promotion and Engineers for Employment" are furnished by Mr. M. M. Meehan, traveling engineer of the D., S. S. & A., Marquette, Mich., who writes:

"These answers are cut pretty short, so as not to take up too much room; many of the answers are simply "Yes" and "No," the intention being to draw out the candidate and allow the examiner an opportunity of asking why. Engineers and firemen on the D., S. S. & A. have no trouble in passing 100 per cent. on this list without the assistance of the answers. Of course, it is understood that the examiner will help the candidate along, and explain any technicalities that may be brought in during the examination. Examiner should not use the examination as a club to do a candidate any harm, or "catch" him, but in all cases the candidate should be allowed the benefit of a doubt, and be set right on all questions that do not appear clear. At the same time, the examiner should draw out the candidate, to find out how well he is posted on the running and care of engines. I fully realize that these answers will be criticised and commented upon to a great extent by many, but this list is what our men pass on and make a success with."

No. 1. A steam engine placed on wheels and used in drawing cars on railways.

No. 2. Try the water in boiler by testing all the gage cocks, and blowing out the water glass, noticing if both top and bottom cocks work freely; notice if flues and crown sheet are all right; examine rods, guides and eccentrics to see if they are all right, and when moving engine out of house, would notice if crosshead was traveling the proper distance, or any other duty that pertained to the work of engineer.

No. 3. All the tools provided in the monthly inventory, and proper blocking, to be used in case of break-down on the road.

No. 4. All the different kinds of oils used on an engine, waste, coal, tank of water and box of sand.

No. 5. Place the engine on top quarter of the side you are going to try; block the main wheel, give engine steam and work reverse lever back and forward until all the points that were pounding have been located.

No. 6. Yes; same as No. 5.

No. 7. Place the engine on the center on the side you are going to work on, slack off all the keys on that side, key the main connection *first*, then adjust the front and back ends in the same manner.

No. 8. Yes.

No. 9. Pinch the wheels away from the wedges, screw the loose wedge up with short wrench, then try the wedge with pinch bar on each side of wheel to note if box moves freely between shoe and wedge, slack off bolt about one half turn to prevent wedge from sticking.

No. 10. Yes; it allows pedestal to work loose and draw down wedge.

No. 11. With piece of hard wood, or nut, or piece of iron that will fit between pedestal and bottom of wedge, to prevent it from dropping, and piece of wood above the wedge to keep it from working up.

No. 12. Yes.

No. 13. When engine is running shut off, pound will be noticed when crosshead is passing the front center.

No. 14. Take off cylinder head and tighten up loose bolt.

No. 15. By watching engine carefully, when passing or leaving the centers, blow will take place, and if cylinder cocks are opened steam will come from both cocks on that side at the same time.

No. 16. Yes.

No. 17. Yes; valve blowing is continual while engine is using steam.

No. 18. Yes.

No. 19. No.

No. 20. Yes; when engine is working, hard continual blow is noticeable in firebox, or when firebox door is opened; when engine is standing, place reverse lever on center and open throttle wide; the greater amount or pressure of steam admitted to steam pipes, the more distinct will the blow be.

No. 21. Slipped eccentric; loose bolts in strap; loose rods on strap; broken valve yoke; bent rocker arm.

No. 22. Yes; by carefully examining and noting position of same in relation to crank pins.

No. 23. Loose exhaust pipe; one exhaust tip of double nozzle; engine gone; bent lifting arm or loose rocker box.

No. 24. Yes; place engine on front center on the side you want to set eccentric, then move eccentric around until it stands at right angles with crank pin, then move eccentric towards the pin 1 in. and it will be close enough to do necessary work or get engine to shop.

No. 25. The effect of a slipped eccentric on the valve is either to increase or diminish the lead; therefore, by running the engine slowly with link, first in full forward motion and then in full back motion, and observing whether the steam is admitted at each end of the cylinder just before the crank reaches the dead points, it will indicate which eccentric has moved. If it has slipped in one direction the lead will be increased, and steam will be admitted to the cylinder some time before the piston reaches the end of the stroke. If it has been moved in the opposite direction the lead will be diminished, and steam will not be admitted until after the piston has reached the end of the stroke. The admission of steam will be indicated by its escape from the cylinder cocks.

No. 26. By keys, set screws and feathers.

No. 27. By moving engine until crosshead is on a line with travel marks on guides.

No. 28. Forward center.

No. 29. Forward motion eccentric is back of pin one-quarter of circle, or 90°, less about 1 inch, to compensate for lap and lead of valve. Back motion eccentric is in advance of pin the same distance.

No. 30. One-quarter of turn or circle back of the corresponding motion on opposite side.

No. 31. Set screws working loose, imperfect lubrication.

No. 32. With an eccentric shifter or monkey wrench, or any other tool that will catch spoke of eccentric.

No. 33. No.

No. 34. No.

No. 35. Take off the other eccentric, link and main rod; block crosshead, and cover ports with valve.

No. 36. Yes.

No. 37. Yes.

No. 38. Yes.

No. 39. Yes.

No. 40. No.

No. 41. Yes.

No. 42. If piston was entirely gone, would disconnect valve rod and stem on that side, cover ports with valve, and clamp the stem. If part of piston remained on the rod and liable to damage cylinder, would take down main rod and block crosshead.

No. 43. Take down main rod, block crosshead, disconnect valve rod and stem, cover ports with valve, and clamp valve stem.

No. 44. Take down main rod, block crosshead, take cover off steam chest, and block between top of valve and steam chest cover, first placing valve in center of travel.

No. 45. Take off steam chest cover, take out valve and remaining parts of broken seat, put valve back in place, put on chest cover, and engine is ready to work same as before false seat was put in.

No. 46. Remove all the packing, except one round of soapstone or hemp, shove the broken gland into stuffing box as far as it will go, screw up nuts on gland studs.

No. 47. Yes; liable to break the valve, bend rocker arm, valve rod; or, if piece of broken seat should work into cylinder, it is liable to break the piston or cylinder head.

No. 48. Cover ports with valve, take down valve rod, clamp the stem, take down main rod, and block crosshead on that side.

No. 49. By wedging between steam chest and steam-chest bolts; slack off bolts near crack first.

No. 50. Take off steam chest cover; block steam inlet with wood, holding the blocking in place with board; set valve on top of board. If inlet is on side of steam chest take off cover, drive plug into inlet or steam passage, block between end of valve and blocking piece. That side of engine to be disconnected.

No. 51. Back end of guides, with blocks of wood cut the proper length and thickness to fit between guide bars, holding them in place with rope or clamps.

No. 52. By blocking crosshead so it will not pass the travel marks on the guides; use small block of wood to fit between crosshead and guide block.

No. 53. Not necessary; disconnect cylinder-cock rod and block the cocks open.

No. 54. Disconnect valve rod and stem on that side of engine; cover ports with valve and clamp it; take off main rod, block crosshead. If crosshead was broken so it could not be blocked, take it down, and piston out of cylinder. If piston rod was bent so it could not be taken out of cylinder, shove it to back end of cylinder and block between piston and cylinder head.

No. 55. Take down rod on opposite side.

No. 56. No; some switch engines have eccentrics connected to the front axle, and the main pin is on the back wheel.

No. 57. To avoid straining, bending or breaking the rods or pins.

No. 58. It brings heavy strain upon the rods and pins, is very liable to break them; it is bad practice.

No. 59. No; it causes uneven wear of tires; should engine slip while sand is running from one pipe it will make uneven strain upon engine.

No. 60. Block on top of back box only. To illustrate: If forward driving spring was broken, run forward wheel up on block or wedge, first placing block on top of this box to raise frame from back driving box, and make sufficient room for blocking between top of back box and frame; not necessary to remove spring unless it is liable to fall in pieces.

No. 61. Same as No. 60.

No. 62. Block between engine-truck frame and equalizers.

No. 63. Block between cross equalizer and boiler; remove broken parts.

No. 64. Jack up front end of engine and front end of long equalizer, place car brass between end of equalizer and engine truck-wheel axle; run slow.

No. 65. If it is the main tire, and no other damage done, remove the cellar; run that wheel up on block until it is the same distance from the rail it was before tire came off; put block between axle and pedestal, and small block between spring saddle and frame, to take weight off block.

No. 66. Same as No. 65.

No. 67. Same as No. 65.

No. 68. Run *both* back wheels up on blocks as far as they will go, first removing back section of side rods; block on top of both main driving boxes, and below the cellars, in boxes that are up on blocks, and between engine deck and tender draw-bar.

No. 69. Same as No. 68.

No. 70. If standard engine, remove side rods and proceed as in No. 69. If mogul, use block of wood or wedge between engine and tender; block to be used on inside of curve.

No. 71. At the fulcrum points or centers of equalizers on mogul, and center of engine truck and center of equalizer on standard engine.

No. 72. Same as No. 71 on good track.

No. 73. Over that box.

No. 74. Iron, made to fit between top of box and frame.

No. 75. Take off some of the weight it is carrying by running it up on wedge, and placing block between spring saddle and frame.

No. 76. Yes.

No. 77. Skid the broken wheels to siding, and remove them; chain engine-truck frame to frame of engine.

No. 78. Take out broken wheel, chain engine truck to frame of engine or remove it, and block on top of front driving boxes.

No. 79. Remove broken wheel, and suspend that end of truck, with chains, to cross tie placed on top of tank.

No. 80. If frame opens enough when engine is working to allow piston to strike cylinder head, disconnect on that side.

No. 81. No.

No. 82. Usually at the cylinder saddle and belly braces, but some roads fasten at the back boiler braces.

No. 83. Yes.

No. 84. Reduce steam so engine can be handled with reverse lever.

No. 85. If the distance was not over 25 or 30 miles, would not disconnect, but would ask to be towed in in that manner; if further, would disconnect in the usual way.

No. 86. No; throw all the babbitt before cooling off.

No. 87. Remove or take off oil-box cover, take out all the packing, jack up the box, take out the wedge or step, take out brass, put in new brass, replace wedge or step on top of brass, take out jack and repack box.

No. 88. Yes; take out cellar, jack up box by placing jack under corner of box, remove old brass and put in new one, take out jack and replace the cellar.

No. 89. Yes; the weight being unevenly distributed over that bearing it is very apt to run hot.

No. 90. At the end of each trip.

No. 91. Give engine thorough inspection, and report all work needed on engine before she makes another trip; work to be reported on book provided for that purpose.

No. 92. See that engine is protected front and rear, then make careful inspection of damage, and send intelligent report of condition of engine to the proper officials.

No. 93. Board it up, using the studs if possible; if not, brace it.

No. 94. Yes; the principle is that steam, being admitted to the injector, enters the combining tube in the form of a jet, near the top of the water inlet pipe. If the water level* is below the injector, the escaping jet of steam, by its action upon the air around it, forms a partial vacuum in the combining tube and inlet pipe. The water then rises to the combining tube by the pressure of air in the tank. Once risen to the jet of steam, the water is acted upon by the steam in the same manner as the air had been acted upon when steam was first admitted to the inner tube of injector.

No. 95. —— ——

No. 96. That part of injector in which the water condenses the supply of steam.

No. 97. No.

No. 98. In the tank; examine strainers in hose and all feed-pipe connections.

No. 99. Overflow valve stuck down, combining tube broken; the jet of steam from forcing steam tube is not in line with the combining tube.

No. 100. Not getting sufficient supply of water to condense the steam.

No. 101. Tap the check box lightly with block of wood, to jar check to seat.

No. 102. On some engines a check valve is placed between line check in injector and boiler check.

No. 103. No.

No. 104. Yes.

No. 105. Yes.

No. 100. The supply of water to the boiler should be continuous while engine is working, and quantity admitted into boiler should be regulated according to the amount of work being done by engine.

No. 107. No; see No. 94.

No. 108. Yes.

No. 109. Foreign substances in the water, such as oil, soap, soda, etc.

No. 110. Shut off steam to ascertain the true level of water by allowing it to settle, open firebox door to avoid blowing off; should water drop too low, would open throttle and put on injectors. If engine had surface cock, would open same to allow impure water to escape; if no surface cock, handle carefully until washed out.

No. 111. Danger of burning crown sheet, cutting valves, breaking packing rings on pistons, knocking out cylinder heads.

No. 112. No.

No. 113. Dump fire.

No. 114. One gage.

No. 115. Depends upon the build of engine; there should be 3, 6 and 9 inches respectively.

No. 116. No; they should *all* be in good working order.

No. 117. No.

No. 118. By shutting off the top cock, water will rise in glass; or opening the throttle will raise water line in glass so it can be seen, if it is not below the bottom cock.

No. 119. Report the condition at once; it is not safe to run an engine in that condition.

No. 120. Yes.

No. 121. It has a tendency to soften any scale that may have formed in boiler; injectors work better and easier, with much less noise, and longer without repairs.

No. 122. No; it will cause boiler to foam.

No. 123. Liable to break packing rings and knock out cylinder heads.

No. 124 No.

No. 125. Yes.

No. 126. Bank or dump the fire, as the case might require.

No. 127. Disconnect to be towed in, break all joints that are liable to hold water, run water out of tank and blow off boiler.

No. 128. Take out whistle or safety valve and fill with pails, by bailing.

No. 129. Yes; plug up all openings that would allow air to get into boiler or cylinders while engine is being towed—cylinder cocks, relief valves on steam chests, overflow of injectors, whistle, open throttle and injectors; reverse lever to be in motion the engine is towed in; the movement of pistons will pump air *out* of boiler, forming a partial vacuum, and will be filled by supply of water from tank.

No. 130. Yes; make coupling to injector of live engine and check of dead engine.

No. 131 By pumping engine regularly, and only when working; keep fire burning bright all the time to keep an even amount of steam, and avoid, as far as possible, the sudden cooling of firebox and flues.

No. 132. Yes; it is a good practice.

No. 133. Yes.

No. 134. Lubricators work on the condensation and gravity principle. With steam and water valves open, sight-feed glasses filled with water, open feed valve; small drop of oil will, of its own weight, feed from end of feed valve; the oil being of lighter gravity, will pass up through glass until caught by jet of steam from equalizing tubes and carried through small nozzle in side of cup into oil pipes that lead to steam chest, in the shape of very fine oil spray.

No. 135. In the event of sight-feed glass breaking, those valves will be seated by pressure of steam from equalizing tubes.

No. 136. No; were other valves between cup and steam chest, oil could not get to steam chest and cylinders.

No. 137. The water valve, to allow oil to expand.

No. 138. Open it.

No. 139. Depends upon the kind of oil used; if the oil is of superior quality, once in three months is often enough; if poor oil is used, should be cleaned every week.

No. 140. Yes.

No. 141. Depends upon the style of lubricator in use.

No. 142. The only sight-feed lubricator that will cross-feed has but one equalizing tube, and that is inside the cup; the lower end of tube is in shape of a tee, and should one of the oil pipes become blocked, oil will be carried to the other side by the single jet of steam.

No. 143. Yes; when engine cools off, a partial vacuum is formed in boiler; if steam and water valves are left open, oil will draw up through the water tube, condenser and extension top and into boiler through the boiler connection.

The men who send out circulars asking for information on which to work out reports of committees, are constantly complaining about the small percentage of replies they receive and of the limited information given by those who send in replies. This short-coming seems to be general with those who are asked to send facts about machine shop operations. We have a great deal of sympathy for a man getting out an engineering handbook, who recently sent requests for information about machine shop operations. Most of the replies he received went on to say that the firm addressed were prepared to supply their products at a certain discount for cash.

On the Great Northern they support the end strips of Richardson's balanced valve packing on projections on the end of the long strips, there being no springs under the end strips at all.

CAR DEPARTMENT.

Conducted by Orville H. Reynolds, M. E.

Proposed Air-Brake Rigging, with Uniform Levers, for All Classes of Freight Cars.

BY B. HASKELL.*

The M. C. B. Association in September, 1893, adopted a "standard for air brakes on freight cars," the details of which show a cylinder and floating lever 9 x $19\frac{3}{8}$ in., and a dead and live lever 6 x 24 in., giving a brake beam load of 7,500 lbs. This brake beam load equals a braking power per car of 30,000 lbs. This plan, as shown, is misleading, as 30,000 lbs. braking power is 70% of 42,865, and there are comparatively few cars weighing this much, so that it is only suitable for cars of the weight mentioned. I think that 90% of the freight cars in the United States weigh less than 42,865 lbs. each. About the lightest weight car this could be used on is one weighing 37,500 lbs., which, in this case, would have a braking power of 80%. If we use this "standard" on cars of less weight, we are going to have trouble with sliding wheels, so that the M. C. B. standard, as shown, can only be safely applied to cars weighing between 37,500 and 42,865 lbs. This standard will not do for flat cars, yet they come under the freight-car class. It would be dangerous for a railroad company to contract for a lot of cars and specify the M. C. B. standard freight-car brakes, unless the cars weighed not less than 37,500 or over 42,865 lbs. It is difficult to determine from specifications just what a lot of cars are going to weigh.

Referring to attached drawings, the plan, as shown in Fig. 1, consists of four different size levers, live, dead, cylinder and floating levers. I have shown it in this way, as it more nearly conforms to present practice. It is, as will be seen, applied to outside-hung brakes. If inside-hung brakes are used, no difference need exist between the dimensions of live and dead levers. This would simplify the plan somewhat, and give one less lever to look after. Even with outside-hung brakes, I believe that the live lever could be used for a dead lever, as brake cylinder can be placed so as to allow just enough angularity to brake rod to allow it to work freely and without striking or binding on dead lever.

*Superintendent of Motive Power, Chicago & West Michigan and Detroit, Lansing & Northern, Grand Rapids, Mich.

Of course, on cars already equipped with air brakes it would necessitate changing the position of dead-lever guide. The advantages to be gained by doing away with two sizes of truck levers will more than compensate for this, I feel sure. The cylinder and floating lever, as can be seen, is the same style, but of different dimensions, as that used in the Hodge system of passenger levers. In Fig. 1, I have shown the application of hand brakes, according to the present practice, and as shown in M. C. B. standard. This plan is defective, as it does not give equal braking power to each truck, and to overcome this defect (if it should be decided advisable to do so) a sheave attached to end of push rod, and a chain anchored at one end and passed around sheave to end of brake rod, could be used. This would give equal distribution of braking power to each truck when hand brake was used, and it would also increase the braking power of the hand brakes, which, I think, is advisable.

If it should be deemed advisable by some to have hand brakes operative from each end of the car, the cylinder lever, as shown with a sheave, could be used for floating lever by using the floating-lever guide that is now in use on cars so equipped. This would simplify matters further by reducing the number of different size levers, and, if live lever was used for dead lever, reduce the number of sizes to two. The same result could be accomplished in another way, by using lever No. 2 for cylinder lever and attaching an auxiliary lever, as shown in Fig. 5. This lever could be made of wrought, cast or malleable iron, and so designed as to give same power as lever No. 4. It could also be attached to floating lever in case hand brake should be desired on each end of car, but only in case both hand brakes were set up would the distribution of braking power be equal. Of course, if plan as shown in Fig. 1 was used, it would necessitate placing both hand brakes on same side of car. This would be objected to by some, but I cannot see why it should be objectionable, as I do not believe that it cuts any great figure.

The use of hand brakes on both ends of car, I believe, was desired mostly by roads placing one of the brake wheels on end of car. Most roads using double brake, place one brake wheel on top of car and one on end. In this case I cannot see where it would be objectionable to have both hand brakes operative on same side of car. As long as brake is operated from end of car, I do not think it cuts any figure which side it is on. Very few roads using two hand brakes apply them both so as to be operative from top of car. Cars so equipped are rare, and as this is the case, the one that is used from roof can still be applied to right side. If cars already equipped with air brakes should be changed to use plan shown in Fig. 1, it would necessitate reversing location of brake beams so as to bring brake levers in proper position, and it would also necessitate changing position of dead-lever guide. This would cost money, but I believe the money could not be expended in a more profitable manner. I believe something has got to be done to standardize the foundation brakes, and after a plan has been adopted, I also believe it would pay to have all cars possible changed. Uniformity in braking power and dimensions of levers is something that is as badly needed as anything I know of in the line of reforms. There is another advantage to be gained by using this style of cylinder and floating lever that cannot be gained by any other plan, and I believe it would be of great benefit, especially to fast freight traffic. The speed of freight trains is increasing; competition calls for it. Take, for instance, the banana trains run from Texas to Chicago; the speed these trains are run at calls for extreme care and watchfulness and perfection of all appliances used. If proper braking power is wanted anywhere, it is wanted on these trains; and with the load they carry, a uniform power of 70% of light weight brings the actual braking power down to a figure that is, I think, rather low for the speed they run.

The advantage I refer to in this style of lever is this: With fast and special loaded freight trains, similar to the banana trains, the braking power can be easily increased just before train starts, by moving pull rods one or two holes nearer the brake cylinder, and at end of trip the rods can be moved back to original position. This plan, if followed, would enable trains to make better time with increased safety, and be, I think, of great advantage. Considerable time could be gained and saved in slowing up and making stops. In-

creased speed of passenger trains has brought out a reinforced brake, and I believe fast freight trains need it as much and more than passenger trains, and this system of levers provides one means of getting it, and it will enable one to get the braking power of loaded freight trains up to near what it should properly be. It is a weak point in our freight brakes that the braking power is of necessity so low when cars are loaded. The handling of empty cars, of course, is the necessity for it. The advantages of plan shown in Fig. 1 are, that it can be operated on cars weighing from 16,000 to 37,000 lbs., giving a braking power ranging from 70 to 77,

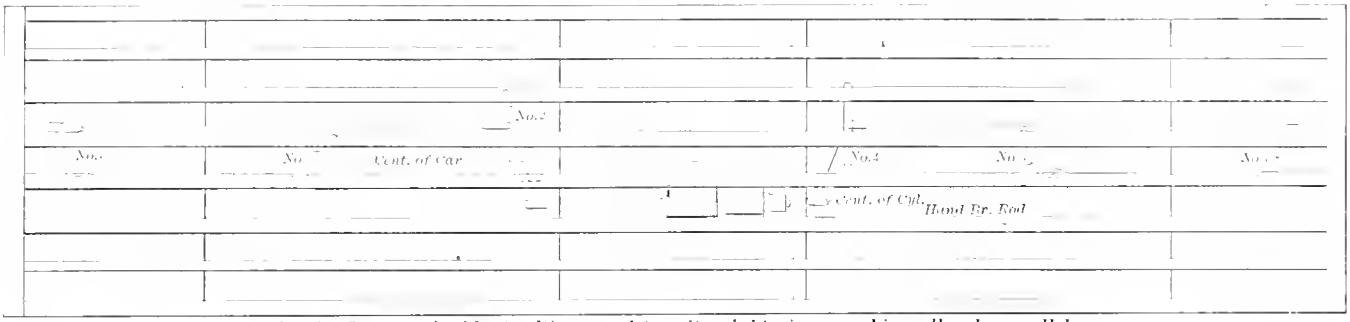


Fig. 1. Levers coincident. Distance A to suit weight of car, making all rods parallel.

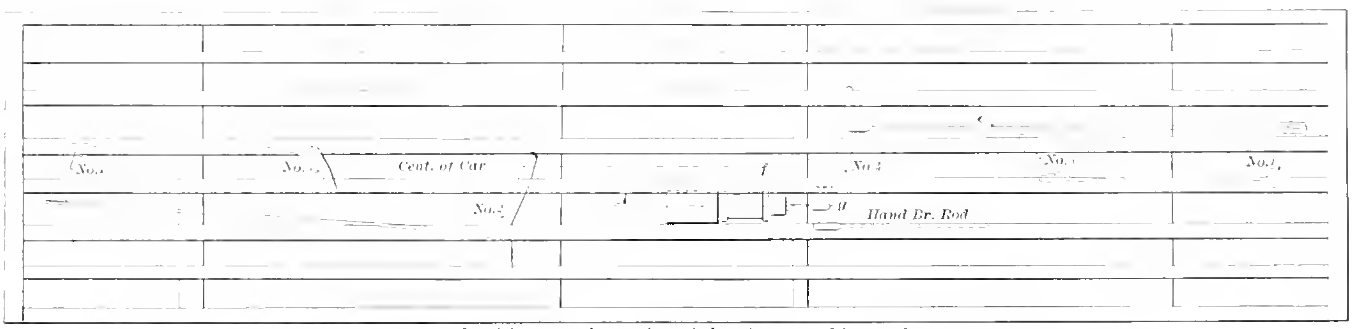


Fig. 2. Levers reversed. Distance A to suit weight of car, making rods e, f, and g parallel.

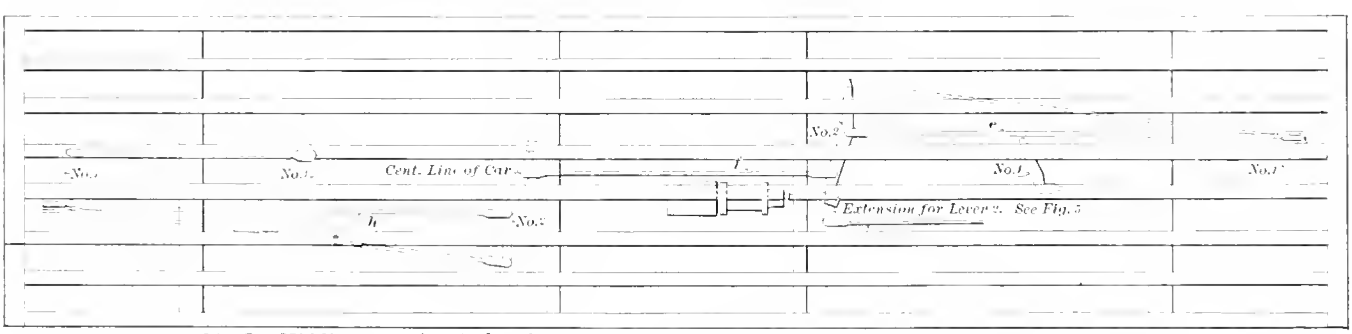
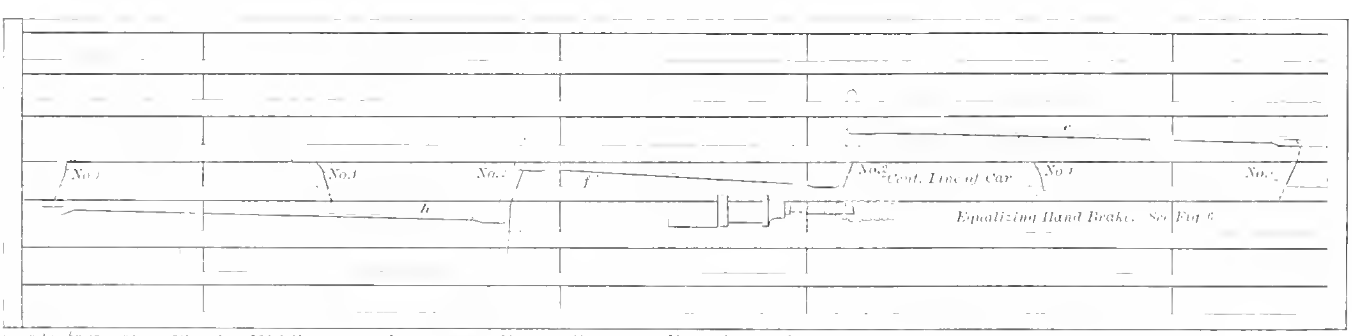


Fig. 3. Middle connection f, placed on center line of car, giving equal angle to top connections e and h.



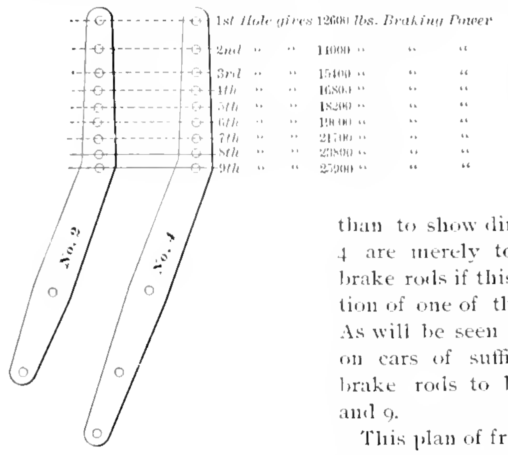
Locomotive Engineering Fig. 4. Middle connection crosses diagonally center line of car, giving equal but reduced angle to rods e and h.

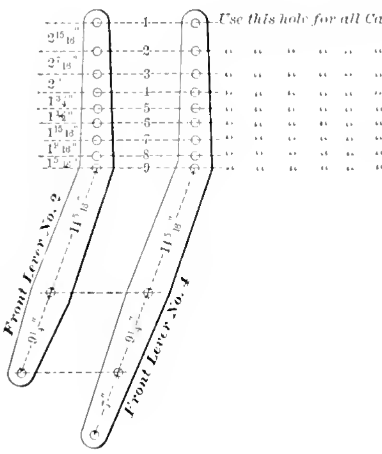
with only two different sizes of levers, and, where a sheave is used for hand brake, an equal hand braking power on each truck. There will be no angularity to brake rods. Weight of car being known, cylinder lever can be stenciled on needle beam in manner shown in Fig. 1, thus placing right before the inspector, or anyone else connecting brakes, information as to which hole it should be connected in, so that he can readily understand and cannot mistake.

The truck lever can be stenciled on truck side in such manner that anyone can readily understand what size is needed in case renewals are necessary. Blueprints of the levers could be supplied all car men, and if only two levers were used there would be no chance for confusion. This plan can be used with double or single hand brakes. The only part about it that would not be standard on all cars is the position of cylinder, and this I do not consider cuts much figure.

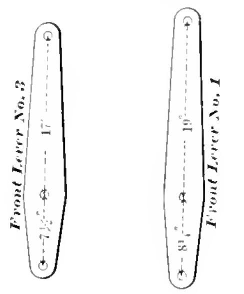
The position of cylinder in reference to center line of car would have to be governed by weight of car. I equipped a car with plan shown in Fig. 1, and made a trial to ascertain what the piston travel would be when using the different holes in cylinder lever. The trial was made with emergency application. When connected in hole No. 1, I got

$3\frac{1}{4}$ inches travel, and when connected in hole No. 9, I got 8 inches travel. Before making trial I adjusted slack so that brake shoes stood $\frac{3}{4}$ inch from wheel. Of





All levers to be 1" Thick, 2½" Wide at ends, 4" wide at fulcrum and all Pin Holes to be 1⅛" diam.



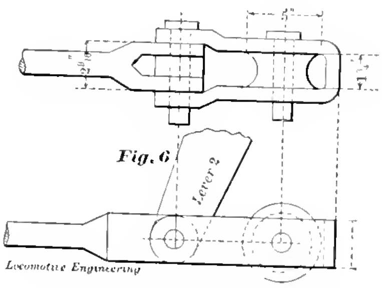


Fig. 6

Locomotive Engineering

Lever 2 with chain sheave dispensing with Lever 4, as shown on Fig. 4 and applicable to all cars.

course 8 inches travel is excessive for hole No. 9, but the slack could have been taken up closer than $\frac{3}{4}$ inch and reduced this travel, and the travel of $3\frac{1}{4}$ inches when connected in hole No. 1 could be increased by increasing slack. The matter of piston travel could possibly be better adjusted, by arranging the dimensions of levers differently than I have done. I do not claim the dimensions of levers are perfect. I have simply taken dimensions most suitable for our cars, as my idea was more to show the plan of arranging the levers than to show dimensions. Figs. 2, 3, and 4 are merely to show the angularity of brake rods if this plan was used, with position of one of the floating levers reversed. As will be seen in Fig. 3, it could be used on cars of sufficient weight to require brake rods to be connected in holes 8 and 9.

This plan of freight brakes will probably be objected to by some of the roads. Some

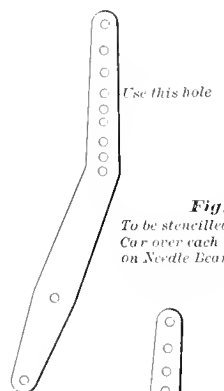


Fig. 7

To be stencilled on bottom of Car over each Cyl. Lever, or on Needle Beam

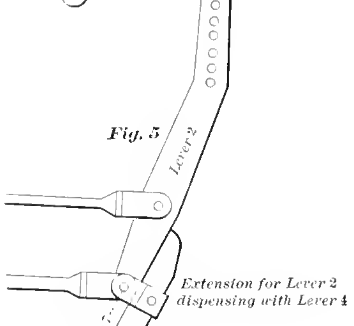


Fig. 5

Extension for Lever 2 dispensing with Lever 4

of the principal objections will be that some cars will have a surplus of iron required for cylinder levers on light cars, and that it is impracticable to have levers suitable for all cars, and that the arrangement of cylinder levers results in increase or decrease in braking power when rounding curves. As regards the first objection, I cannot see that it makes any difference whether a surplus is carried on the cars or in stock. With several different sizes of cylinder or truck levers, it is necessary for the store department and inspectors to carry a stock of several different sizes of levers; but where a standard, such as I have shown, is used, it will only be necessary for the store department and inspectors to carry in stock the same number of these levers as they do of any one size of the others. This will more than offset the surplus of iron carried on cars requiring light braking power, so that the stock material in levers owned by the road will be less than where different sizes of cylinder and truck levers are used. As to its being impracticable to use the same levers on all cars, I believe the same levers can be used on 90% of the freight cars in service to-day—even if they could only be used on 75% it would be an advantage. Uniform braking power of this proportion would certainly be advantageous. The M. C. B. report of the C., B. & Q. test would indicate that some thought the application of air for successful braking was impracticable, and it was thought electricity would finally have to be used; but subsequent developments would indicate that air is practicable for braking purposes.

I do not think the use of standard brake levers is as difficult a problem to solve as some of the other problems that have been presented in connection with freight cars. I, for one, am not willing to admit its impracticability. The increasing or decreasing of braking power when rounding curves with this plan will probably occur, but I have never known of any results on passenger cars that would indicate that it cuts any great figure, and the results would not be any more apparent on freight cars. This defect, if it is one, will be taken care of by the expansion or compression of the air pressure in brake cylinder, and I do not believe the variation of braking power would be perceptible. There may be other objections to my plan, but I believe they can be met. There is one thing, however, that would be obtained, and that is, more uniform braking power than has ever been obtained before. This is, I think, the most important feature of all. The condition of affairs at present, if properly named, would be "breaking power" instead of braking power, and I am in hopes that the M. C. B. Committee on Brake Levers will come to some conclusion and adopt some plan that can, when in service, be properly called "braking power."

Strength of Standard Axles.

There was a decidedly spicy meeting of the Western Railroad Club over a statement which Mr. D. L. Barnes made concerning "Strength of Car Axles" This was one of the subjects chosen for discussion, and Mr. Barnes was asked to open it. He prepared a diagram, worked out according to the rules laid down in the best engineering books, as to the transverse strain on vertical beams to show the safe load that could be carried by the M. C. B. standard axle, with journal $4\frac{1}{4}$x8 inches.

The lines of the diagram seemed to indicate that the standard axle is too weak for loads over 40,000 pounds, and the author attributed the common breakage of axles to the fact that they are too weak for the strains they are subjected to. Another point made was that the axle should be straight between the wheels. This point was also made by Mr. L. S. Randolph in a paper read at the last meeting of the American Society of Mechanical Engineers. The assertion was made that the factor of safety of a standard axle is only about one and a half, whereas in bridges, rails and other structures the factor of safety is five.

The railroad men present disputed the correctness of the calculations on which the diagram was based. Mr. A. M. Waitt considered the fact that so few axles break under cars of 60,000 pounds capacity as proof positive that the axle was strong enough. Mr. J. N. Barr attacked the statements with much vigor. The best of his argument reads: "The axle of the present day is a growth of our experience. We used to have experience with straight axles, axles with small wheel fits, and we found they broke inside of the hub. But we did not find them breaking in the center. Then the thing to do was to commence to build up the axle at the wheel fit. We did that, with the result that we have had no trouble with breaking in the center, and have corrected the tendency to break inside of the hub, so that the axle, as it stands to-day, is the result of actual experience. By gradual growth we have removed the difficulties."

Reading the lesson of past experience, Mr. G. W. Rhodes remembered that they used to have much trouble with axles breaking when they were straight in the center, and that failures had been very rare since the tapered form was adopted. This seemed to prove that it would not be wise to return to the straight axle.

Various reasons were suggested by Mr. Wm. Forsyth to explain why axles did not break, although Mr. Barnes' figures might be correct. But he disputed the correctness of an important rule used in making the calculations. Mr. Barnes had stated that the strength of the axle varied with the fourth power of the diameter, and the calculations were based on that formula. Mr. Forsyth held that it ought to be the cube of the diameter. This makes a very important difference.

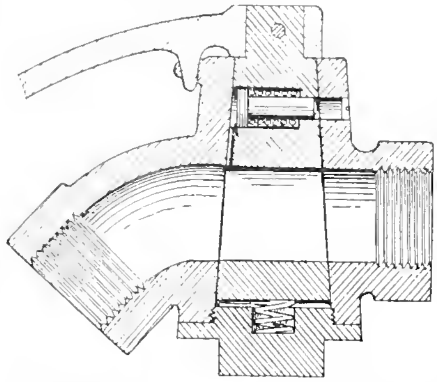
The discussion did not prove anything conclusively, except that it is very desirable that some careful figuring should be done to ascertain exactly the margin of strength allowed in the dimensions of the standard axle. If it can be proved that the margin of safety is less than five, a new form ought to be adopted.

There has always been a tendency among the majority in the Master Car Builders' Association to make the standard axle as small as possible, and this has led to repeated enlargements.

Automatic Lock for Angle Cocks.

Our illustration is of a new device in the way of an angle cock, recently patented by Mr. Geo. M. Tower and T. R. Rich, of Fitchburg, Mass.

Across the top of the plug they drill a hole that serves as a cylinder for a little piston plug, with a spring back of it; a



passageway from the pipe is made behind this piston, as shown. When air is in train line, the piston is forced out and locks the plug by entering the hole opposite.

Where this is used on all angle cocks and cut-out cocks, every cock in the train is locked open when the pressure is put in train pipe, and none of them can be unlocked until the pressure is reduced below 20 pounds, when the spring forces the piston plug to the unlocked position, as shown.

If this little piston can be kept tight, if the plug hole won't collect dirt, and railroads decide that there is anything wrong with the ordinary angle valve (which we doubt), then this is a neat and cheap device to accomplish the ends sought. The makers have had some of the valves in use, and claim they work entirely satisfactory. Anyone interested can get any further information desired by addressing the inventors as above.

To Avoid Hot Car Boxes.

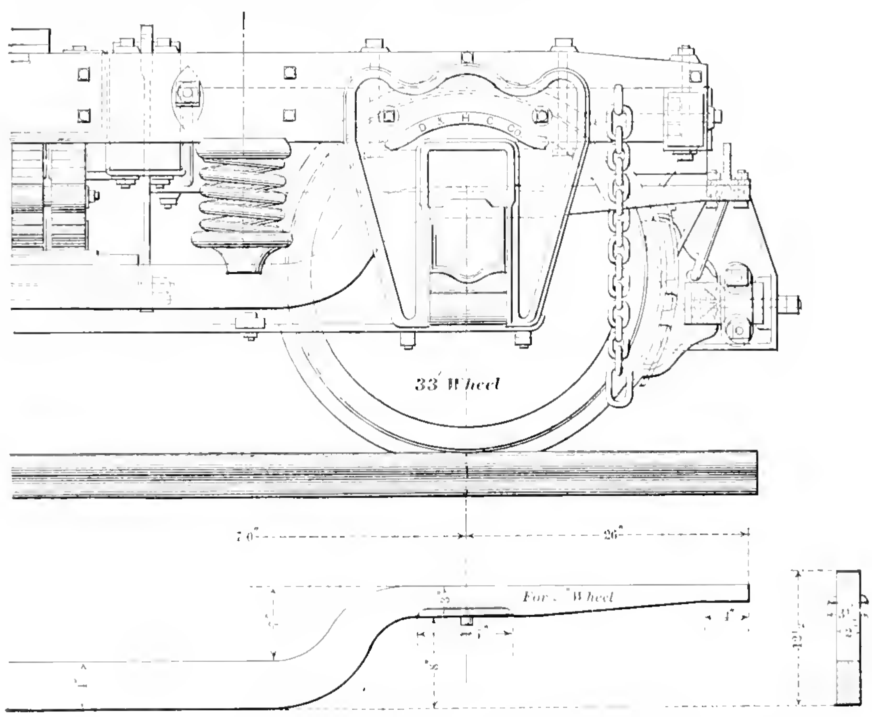
There has been no end of discussion on this subject, and it appears that many of those who talk about the annoyance of hot boxes try to go away as far as possible from common sense in trying to locate the cause of the trouble. We consider that Mr. F. D. Adams covered the whole ground in a few words in his talk at the New England Railroad Club on "The Cause of Hot Boxes and What Can Be Done to Obviate Them."

The first necessity which he mentioned as a preventative was decent brasses. In the course of his talk he showed brasses which had made 3,500 miles to the ounce of material worn off. This proved that remarkably good material was employed. Hot boxes are practically unknown on the road—a happy condition of affairs due to the use of good brass and good lubricants. Those who try to save in the quality and quantity of oil used in car oil boxes generally pay at the other end in the shape of hot boxes, hard-pulling cars and annoying delays.

An Anti-Tilt Truck.

Our illustration shows the details of construction of a passenger-coach truck, lately put into service on the Delaware & Hudson.

The improvement consists in extending the equalizer across the box and beyond the wheel far enough to carry the brake-beam hangers.



When the brakes are applied to a truck of this kind, there is no tendency to pull down the front end of the truck frame and push up the rear end; the straightening of which, when the brakes are released, causes that disagreeable lurch of the car.

So far the improvement seems to be a successful one, and several cars are now fitted with it, and more are being applied all the time.

Depreciation of Freight Cars.

Cars, like all things mundane, suffer from the ravaging tooth of Time, and the degree of such loss of value is commonly estimated on the basis of a certain per cent. of their annual depreciation, limited to an arbitrary part of original cost.

This is usually taken at 6 per cent. for body and trucks, all parts included except certain portions of the air brake. This method of reaching results is a short cut involving but few calculations, which, while they are of no particular value except to the owner, are jealously guarded from the public gaze.

A table gotten out to show a comparative statement of shrinkage due to age is presented to our readers as something new in the way of reaching the annual depreciation of cars.

It is not necessary to say much by way of explanation, for it is believed the data given is sufficiently plain to explain itself. The upper line shows value of the parts when new; the second line shows deterioration at end of the first year, and this is carried down to the fifth year for wheels, and tenth year for axles and journal bearings, at which period they are supposed to reach the scrap stage.

The wood and iron work are carried out to fifteen years, while the comparison of the old and new method is taken for five years only, for the reason that the car will have a new value by the introduction of new wheels at the sixth year.

The difference in value of car, between old and new method for each year, is shown in extreme right-hand column, in which it is seen that the car is worth $15.38 more at end of first year, and $49.17 at end of fifth year of service, than it would have credit for on the 6 per cent. per annum basis.

A study of the table may prove interesting to many who have not had the time to devote to the details of this matter.

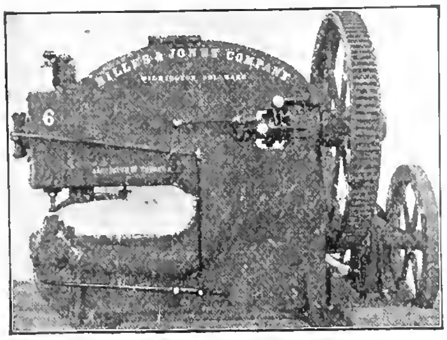
DEPRECIATION OF STABLE CAR.

Years in Service.	Value of One Wheel.	Value of Eight Wheels.	No. of Years.	Value of One Axle.	Value of Four Axles.	Value of Bearings to be Computed by Their Thickness in Sixteenths of an Inch.	Value of One Bearing in Sixteenths of an Inch.	Value of Eight Bearings in Sixteenths of an Inch.		Value of Air Brake.	Value of Wood Work.	Value of Iron Work.	Value at end of Each Year by New Method.		Value at end of Each Year by Old Method.		Difference.
Value, new......	$8.50	$68.00	New.	$9.00	$36.00	1 in. Scrap price 45c+96c =	$1.41	$11.28	New.	$40.00	$217.80	$441.05	New..	$815.03	New..	$815.03	
End of 1st year.	7.60	60.80	1	8.45	33.80	15/16 " " " 45c+86c =	1.314	10.51	1st yr	40.00	203.28	433.12	1st yr	781.51	1st yr	766.13	$15.38
" 2d " .	6.70	53.60	2	7.90	31.60	7/8 " " " 45c+76c =	1.218	9.74	2d "	40.00	188.76	424.29	2d "	747.99	2d "	720.17	27.82
" 3d " .	5.80	46.40	3	7.35	29.40	13/16 " " " 45c+67.2c =	1.122	8.98	3d "	40.00	174.24	415.40	3d "	714.48	3d "	676.96	37.52
" 4th " .	4.90	39.20	4	6.80	27.20	3/4 " " " 45c+57.6 =	1.026	8.21	4th "	40.00	159.72	406.63	4th "	680.96	4th "	636.35	44.61
" 5th " .	4.00	32.00	5	6.25	25.00	11/16 " " " 45c+48 =	.93	7.44	5th "	40.00	145.20	397.70	5th "	647.34	5th "	598.17	49.17
" 6th " .	......	......	6	5.70	22.80	5/8 " " " 45c+38.4 =	.834	6.67	6th "	40.00	130.68	381.80	6th "	....	6th "	....	......
" 7th " .	......	......	7	5.15	20.60	9/16 " " " 45c+28.8 =	.738	5.90	7th "	40.00	126.16	365.91	7th "	....	7th "	....	......
" 8th " .	......	......	8	4.60	18.40	1/2 " " " 45c+19.2 =	.642	5.14	8th "	40.00	101.64	350.01	8th "	....	8th "	....	......
" 9th " .	......	......	9	4.05	16.20	7/16 " " " 45c+ 9.6 =	.546	4.36	9th "	40.00	87.12	334.10	9th "	....	9th "	....	......
" 10th " .	......	......	10	3.50	14.00	3/8 " " " 45c 0	.45	3.60	10th "	40.00	72.60	318.20	10th "	....	10th "	....	......
" 11th " .	......	......	11	......	......	......	......	......	11th "	40.00	58.08	292.75	11th "	....	11th "	....	......
" 12th " .	......	......	12	......	......	......	......	......	12th "	40.00	43.56	267.30	12th "	....	12th "	....	......
" 13th " .	......	......	13	......	......	......	......	......	13th "	40.00	29.04	241.85	13th "	....	13th "	....	......
" 14th " .	......	......	14	......	......	......	......	......	14th "	40.00	14.52	216.40	14th "	....	14th "	....	......
" 15th " .	......	......	15	......	......	......	......	......	15th "	40.00	00.00	190.95	15th "	....	15th "	....	......

Wheels remaining in service longer than five years will be valued at $4.00 each thereafter.
Axles remaining in service longer than ten years to be valued at $3.50 each thereafter.
Value of wheels and axles to be computed from date of replacement.

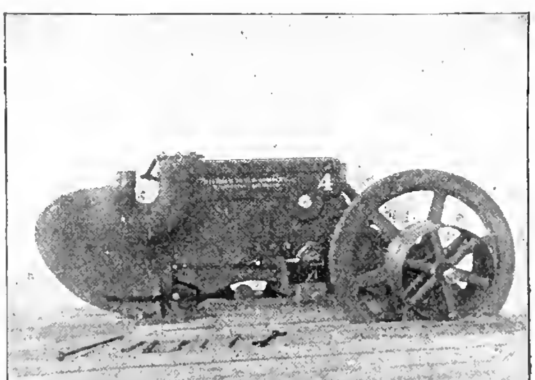
Some Modern Boiler-Shop Tools.

The first illustration shows a No. 6, Hilles & Jones Co. (Wilmington, Del.), single punch and shear, with 54 in. depth of



No. 1

throat. This machine has capacity for punching a 6-in. diameter hole in 1-in. thickness the extreme depth of throat, and is conveniently arranged for handling light work as well. The clutch is worked by an improved adjustable automatic stop, which will bring the sliding head to rest



No. 2.

at any desired point of the stroke. The driving, as shown in cut, is by pulleys at right angles to the machine, which is often a convenience in belting. These builders make a large number of improved patterns of this general line—any depth of throat up to 72 in.

The illustration of the horizontal punch represents one of their No. 4 size, which is a very substantial and convenient tool, having capacity for punching 1½-in. diameter holes in 1¼-in. thickness. The die is held in a forged steel stake, which is keyed directly through the nose and provides a substantial support for the die, at the same time allowing bent flanges, small diameters of pipes, etc., to be conveniently handled. On this tool there is also one of their adjustable automatic stops, which make the machines easier to handle and much quicker in operation.

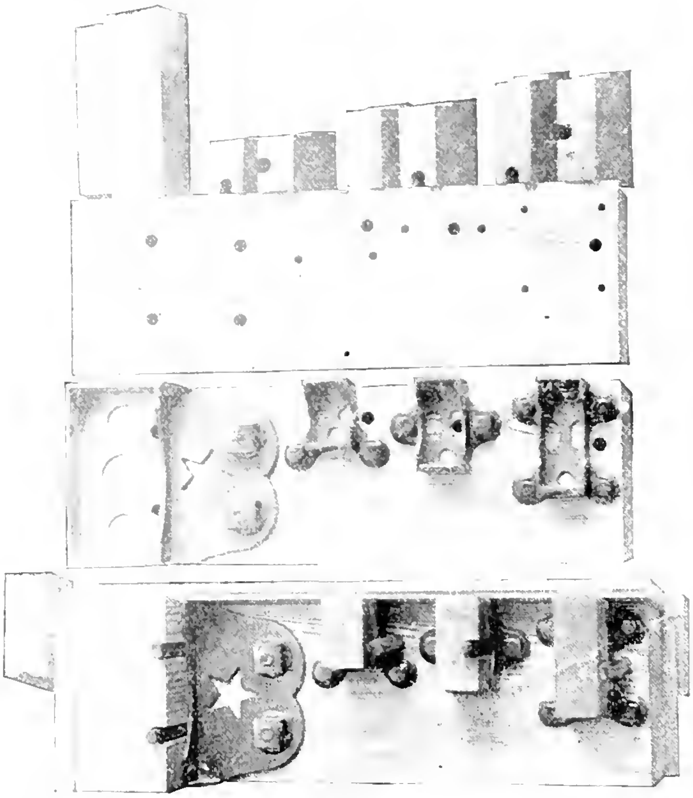
Both machines are self-contained; wearing parts are large and carefully designed to take up lost motion. They build horizontal machines for almost any capacity and any ordinary depth of throat.

Geo. W. Hoffman, 295 Washington street, Indianapolis, who is sole manufacturer of Hoffman's infallible "U. S." metal polish paste, used and indorsed by the Southern Pacific and other railroads, and the Pullman Palace Car Co., reports largely increased sales of this metal polish among the railroads. It is claimed this is the only polish that does not shrink, become rancid, gummy, tough, sticky or hard. A small sample is sent to anyone writing for it.

The Gisholt tool grinder is one of the class where the operator moves several things at once in order to grind the proper shape; sometimes this is hard to do. At the Columbus, O., shops of the Panhandle, they put a small eccentric on the shaft to move the feed table back and forth; this gives the man time to get in his angle moves and handle his work faster, and insures the face of the stone being worn evenly.

Malleable Iron Carlines and Sill Pockets.

It is well known that in the framing of freight cars the strength of important members of the structure is reduced considerably by the material which must be removed for mortises and tenons. This method of framing also makes it difficult to remove any single member of the car



frame for the purpose of making repairs. These objectionable features are avoided by the malleable iron carline and sill pockets, which the National Malleable Castings Company are making, under patents controlled by Mr. W. E. Coffin, of Marshall, Tex. Samples of these pockets are shown in Fig. 1 of the accompanying illustration, the lower view showing several of them of different sizes, attached to a side plate, and with the ends of the carlines in place; the intermediate view shows the same pockets with the carlines removed, and the upper view shows the plate and carline ends drilled and ready to be put together. In Fig. 2 are shown pieces of freight-car plates and carlines, which illustrate in a striking manner the way in which the parts are weakened by the present method of framing.

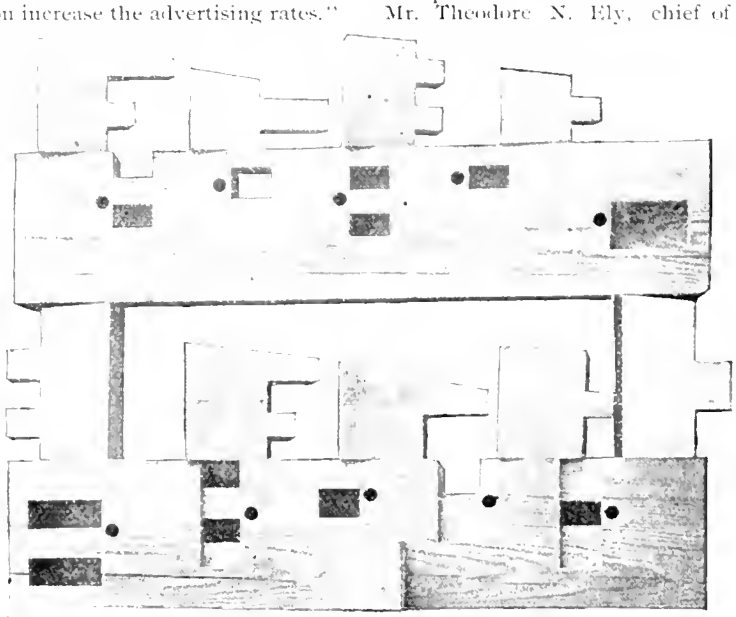
The advantages of these carline and sill pockets may be summed up as follows: They save the time and expense of mortising and tenoning timbers, and also reduce the cost of erecting the frame work of a car; and the sills and plates are not weakened, as in the present construction; and the time required in renewing end or side plates, carlines or sills, is greatly reduced, as by removing the bolts which hold the carline or sill pocket, a timber can be removed without spreading the frame or disturbing the adjacent parts. They are made in all sizes and shapes by the National Malleable Castings Company, from whom further information may be obtained by applying to the office of the railway department of the company, 1525 Old Colony Building, Chicago.

Kind Words.

We have received the following letter from the Joseph Dixon Crucible Co., Jersey City:

"We hand you enclosed herewith something for your columns which we believe will very much interest your readers. We have evidence almost daily of the extended circulation of LOCOMOTIVE ENGINEERING, and better yet, evidence of its being the most carefully read by the mechanical men of the railroad companies. Through its columns we have been enabled to reach many of the engineers and master mechanics of even the Spanish countries. Any number of letters have been received from Mexico for samples of Dixon's Lubricating Graphite and our pamphlet on the subject.

"We write you this to tickle you, not to have you increase the advertising rates."



Nicholson Files and Rasps.

The products of the Nicholson File Company, Providence, R. I., have attained a world-wide reputation. The strictly high-grade character of the files and rasps made by this concern, due to the superior quality of material used and the improved methods, skill and care employed in their manufacture, has won the favor and patronage of discriminating users of such tools. The Nicholson Company enjoy the distinction of operating the largest and most complete file works in the world, having three distinct plants.

They make over three thousand varieties of increment cut files and rasps, including the famous "Nicholson," "American," and "X. F." files. These brands have become standards. No matter for what class of work files are wanted, the Nicholson File Company are prepared to furnish a superior article for the service required. This is a good thing to make a note of.

We have received an illustrated catalogue of the Elliott Frog & Switch Co.'s Works, East St. Louis, Ill. It contains a bird's-eye view of the works and engravings of all the switches, frogs, crossings and track appliances made by the company. There is a very great variety of them. Besides the track fixtures, it contains illustrations of many tools used for railroad work, which are made by the company, among them being track drills, claw bars, mallets, picks, tamping bars, and everything, in fact, that is used in the repair and maintenance of track. The book is very convenient for the pocket, being bound in morocco leather and got up in first-class style. Those interested in the maintenance of track can obtain the catalogue on application to the company.

Mr. Theo. N. Ely writes us: Please note, for your information, that the Pennsylvania Railroad Company will be represented at the approaching meeting of the International Railway Congress by the following delegates: Mr. Frank Thomson, first vice-president, Pennsylvania Railroad Company; Mr. James McCrea, first vice-president, lines west of Pittsburgh; Mr. Theodore N. Ely, chief of motive power; Mr. James L. Taylor, general European passenger agent. This company has been a member of the congress for about ten years, or from about the time of its organization.

High-Speed Locomotives.

BY WILLIAM BARNET LE VAN.

Fast passenger trains are what is sought after by the traveling community, and we often hear of spurts of seventy and eighty miles an hour for short distances—five or six miles continuously.

The writer has ridden upon many locomotives and fast trains, for the purpose of ascertaining their average speed for a continuous stretch of eighty miles. The fastest commercial trains do not average one mile per minute, although I have ridden on them at the rate of eighty miles an hour for short distances. The space to be covered between Germantown Junction, Philadelphia, and Jersey City, is eighty-four (84) miles, and the average speed for a continuous run is forty-nine (49) miles an hour.

According to my knowledge of the locomotives employed, weight of train and the roadbed, this is a fair result, but I am satisfied that for continuous runs between the two points above mentioned sixty (60) miles an hour can be accomplished, by the adoption of a locomotive arranged with *a single steam cylinder and a single pair of driving wheels.*

English railway superintendents have found by actual tests, that for fast continuous runs, a single pair of driving wheels must be adopted. The average speed of their fast trains, corresponding to our five and six car trains on the Pennsylvania Railroad, is fifty-three (53) miles an hour, and by reducing the friction of the locomotive, by the adoption of a single steam cylinder, and a corresponding reduction in gear in connection with a single pair of driving wheels, a mile a minute can be easily maintained for long continuous runs.

It is a fact well known to all intelligent engineers, that locomotives are constructed so as to be capable of developing initially the power requisite to start the trains which they are intended to draw, and this initial power, as is also well known, is about fifty (50) per cent. greater than that afterwards required to continue the motion of the train, under like conditions of grade, etc.

I am not at all willing to concede or admit that two steam cylinders are necessary or advantageous for a locomotive, although two are almost always applied. Messrs. Stephenson & Howe and F. W. Webb, of England, Mr. Phleger and Mr. Smith, of America, it is true, designed a large number of three-cylinder locomotives, and the Baldwin Locomotive Works have built a large number of four-cylinder ones. Again, on the other hand, a considerable number of single-cylinder locomotives have been made by Neilson & Co., of Glasgow, Scotland.

In America, the majority of our fastest and most effective steamboats and steamships were equipped with single steam-cylinder engines up to a few years ago. In England, on the contrary, almost all marine engines had two steam cylinders. In 1853 I was an engineer on the *Quaker City*, a steamship built by Merrick & Son, of Philadelphia; she was a side-wheeler with a single steam-cylinder side-lever engine. When the steamer *Pacific*, of the Collins line, was lost, our ship agreed to carry the United States mails to Liverpool, England. We were fourteen days in crossing, having heavy weather. We lost our starboard wheelhouse, but we weathered the storm. When we arrived in Liverpool we were visited by a great many English engineers, none of whom could understand how we ever succeeded, with only a single engine, in crossing in safety. They also referred with astonishment to the fast time made by single-cylinder engines on our steamboats in America.

As for propellers, there are many engineers who are loath to believe that a single-cylinder engine is as effective and reliable as a two-cylinder one, but the fact is well established that one cylinder is sufficient for the fastest propellers, and they are most economical in fuel consumption. All the best and fastest lake steamers had single steam cylinders up to and until the introduction of the compound engines (which are, in fact, only a continuation of the single cylinder to utilize all the heat units in the steam).

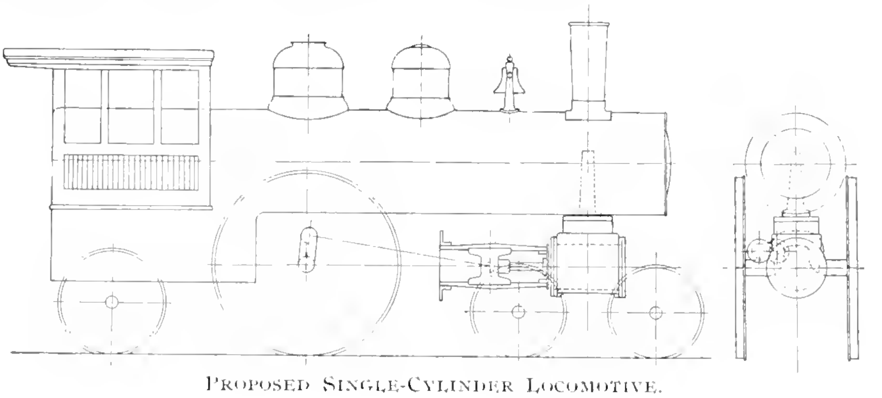
The paddle wheels and propellers of steamships form fly-wheels of great weight, which serve to keep the engine in motion when started. In our stationary engines, with the aid of a heavy fly-wheel, a single cylinder arranged with a detachable cut-off can be run at pleasure with an admission of steam on one end of the cylinder only. In gas and caloric engines, the power is applied in one direction only, the piston being brought back by the fly-wheel.

In the case of a locomotive, the momentum of the train, once in motion, is the most effective fly-wheel, and the engine once started would run with an admission of steam on one stroke only at each revolution of the wheels.

A locomotive with a steam cylinder 24 in. diameter would equal in area two 17-in. diameter cylinders. What engineer can doubt that, with but one piston, cross-head, connecting rod, valve, link and set of eccentrics, the single-cylinder arrangement would run with considerably less friction, even when transmitting the same power as would be developed in two cylinders, while it is evident that single-cylinder locomotives would be much lighter and cheaper than the complicated arrangements now in use?

The adoption of single cylinders would make a revolution in locomotive construction, and would result in great economy. The coal consumption between Philadelphia and Jersey City, distance eighty-nine miles, averages about sixty pounds per train-mile, while by the adoption of a single steam cylinder and a pair of single drivers, the coal consumption could be reduced to about forty pounds per mile.

Ask any engineer who has ever had one side of his engine broken down, and was forced to disconnect the connecting rods on the disabled side, if he has not been able to make his schedule time with his single cylinder, and also the fact that he was able to maintain his steam pressure much better than when two cylinders were in use. He would probably respond in the affirmative.



PROPOSED SINGLE-CYLINDER LOCOMOTIVE.

The objection raised against single-cylinder locomotives is the difficulty of starting the train, in case the engine should stop with the piston on the extreme end of the stroke (on the dead center, as the engineer terms it). Now, I propose to overcome this difficulty by casting on the driving wheels, under the flange tire, a toothed rack into which a pinion could be engaged, the shaft of which could be operated by small engines (rotary preferred), to start it when the engine was on the center.

The pinion could be so arranged that it could be quickly thrown in or out of gear, the same as the back gear of an engine lathe. The use of small engines to assist in starting large engines is not new, as a great many marine engines are so fitted to help start the valve motion of the steam cylinders; also in locomotives, for working the reversing gear and also for the air brakes.

Again, inside-cylinder locomotives are less costly to build, especially so with only one steam cylinder and the necessary connections, and for extremely fast running, an inside-cylinder locomotive is better than an outside one.

The advantage of a single pair of driving wheels for locomotives has been demonstrated by the best English practice for the past twenty years, namely, by the Great Northern Railway of England, Mr. Patrick Sterling, superintendent, whose "singles" are averaging fifty-three (53) miles an hour with a coal consumption of twenty-three (23) pounds per mile. Also by the Midland Railway, S. W. Johnson, superintendent, whose "single" locomotives, with inside cylinders, are hauling trains of 240 tons between London and Leicester, distance 98 miles, at a speed of fifty-one (51) miles per hour with a coal consumption of twenty-six (26) pounds per mile, including all the fuel used in raising steam and in running $3\frac{1}{2}$ miles from train shed to St. Pancras station, London, and back each day. The longest run these locomotives make, without stop, is 124 miles. Considering the loads, speed and grades, these locomotives perform the hardest work of this character that is accomplished in England.

One of the fastest running locomotives in England is No. 123 of the Caledonian Company, which, during the great "railway race" of 1888, drew the West Coast train between Carlisle and Edinburgh, when 101 miles were covered in 104 minutes, some of the grades being $1\frac{1}{2}$ per cent. (76 feet) per mile; coal consumption thirty-two (32) pounds per mile.

The Northeastern Railway is operated by Messrs. Worsdell and Von Borris compound locomotives, inside cylinders, with single pair of drivers, the average coal consumption being twenty-seven (27) pounds per mile. One of these locomotives hauled thirty-two (32) empty coaches a distance of 67 miles in 78 minutes; weight of train, 270 tons. All of the above locomotives are fitted with pneumatic or steam sand-blast for increasing adhesion.

It has been demonstrated, and will probably be vouched for by every locomotive engineer, that for fast speed, easy riding and economy in coal and repairs, nothing can equal a locomotive with inside cylinders and a "single" pair of driving wheels.

The adhesion of a locomotive is the measure of its power, other things being equal. The useful work which a locomotive is capable of performing is, of course, limited by the co-efficient or proportion of adhesion which exists, or can be created, between the driving wheels and the rails; in other words, as soon as the effect of the steam in the cylinders produces a tractive force greater than the adhesion, "slipping" is the result. In ordinary practice the co efficient of adhesion is found to be equal to one-sixth ($\frac{1}{6}$) of the weight resting upon the driving wheels.

The amount of adhesion required to turn to account the whole power which a locomotive is capable of developing varies inversely as the speed at which the locomotive is run—*the higher the speed the less being the adhesion required.*

Take a locomotive capable of supplying steam sufficient to develop in the cylinders 10,000,000 foot-pounds of work per hour, over and above that required to overcome the frictional or other resistances of the locomotive itself. If, now, the locomotive is moving at a speed of but 1,000 feet per minute, or about twelve miles per hour, a pull of 10,000 pounds will have to be exerted to use up the power developed, and the adhesion will have to be such as will enable this pull to be exerted without causing the locomotive to slip. If, however, the speed of the locomotive be increased to 8,000 feet per minute, then the pull necessary to use up the 10,000,000 foot-pounds of available work developed per minute in the cylinders would be as follows:

$$\text{Work} = \frac{10,000,000}{8,000} = 1,250 \text{ pounds only,}$$

and the adhesion weight would be only *one-eighth* ($\frac{1}{8}$) of that necessary in the case first supposed.

From the above it will be seen that in locomotives running at slow speeds it is desirable to have a great proportion of the weight available for adhesion, yet in the case of fast-running locomotives this is by no means always necessary, particularly if the trains run by fast locomotives do not require to be started very quickly. In freight and shifting locomotives, running at slow speed, coupled driving wheels have all the available weight for adhesion, but at high speeds this advantage ceases.

If the rails be perfectly clean and dry, the adhesion is increased; if wet, it is but little reduced. A greasy rail and misty weather will reduce the adhesion as much as sixty (60) per cent., and the result is a considerable amount of "slipping" takes place. This, in the present state of the arts, is nearly overcome by the improved steam or pneumatic track-sanding apparatus, which completely removes many of the difficulties attending the old method of letting sand fall by gravity on the rail. When sand falls by gravity, owing to the slow velocity with which the sand issues from the pipe, it is very liable in a side wind to be blown off so as to fall clear of the rail. It is, moreover, very wasteful of sand, as it is impossible to regulate the delivery so as to give a constant and even supply during any considerable time. All these objections, however, are obviated in the new sanding apparatus, as the sand is delivered at a high velocity directly to the point of contact of the wheel and the rail, and the amount supplied can be controlled perfectly.

The power of locomotives depends principally upon two elements, their heating surface and their adhesive weight; that is to say, the weight resting upon the driving wheels. All experiments show that the faster a locomotive runs, the greater is the production of steam per square foot of heating surface, and consequently the greater is the amount of work developed. As far as the production of steam is concerned, it is advisable to increase the speed as much as can be done without injury to the working parts.

In my ideal single-cylinder locomotive, I propose it to be of minimum weight with a maximum power. To accomplish this I must have a high piston speed. I, therefore, have adopted a stroke of thirty (30) inches with a cylinder diameter of twenty-four (24) inches, as before stated; driving wheels are to be eight (8) feet diameter, which will correspond to two hundred and ten (210) revolutions per minute, and a piston speed of one thousand and fifty (1,050) feet.

The boiler to be made of best mild steel, designed for a steam pressure of two hundred (200) pounds, butt-jointed, with double-covered strips, circular seams single riveted. The boiler to contain 198 flues two (2) inches in diameter, thirteen (13) feet long; firebox 42 x 84 inches. Heating surface in firebox 130 square feet, flue surface 1,350 square feet, total heating surface 1,480 square feet. The firebox to be fitted with a brick arch; also a deflector plate for the fire-door. Grate surface 25 square feet.

For starting from a state of rest, I have a pair of steam cylinders, connected to suitable gear pinions, engaging with the teeth of the driving wheel, so arranged that they can be thrown in or out of gear while in motion; therefore, the auxiliary engines are only used for starting.

"Big Four" Yards.

The Cleveland, Cincinnati, Chicago & St. Louis people have got particularly well arranged car yards at Indianapolis. The arrangement for taking care of the passenger cars is especially worthy of attention, and the handsome appearance of the cars shows that they are unusually well attended to. In connection with the car shops, they have an excellent arrangement of bins for holding all kinds of castings and material. This is run on the card system, and those in charge can see at a glance how much stock of every kind there is on hand. It was a little difficult getting this system into easy working order, as the men were inclined to take out material without leaving a record, but a little attention worked them into the practice of recording what was taken, and the system now runs very smoothly. Every kind of material—iron and lumber—that goes into a car is controlled by this system, and these shops have been using up a great deal of scrap in the last few years, and have bins arranged for the different kinds of articles. In the past year the use of old material in repairs has averaged 65 per cent., and some months it has gone as high as 78 per cent. The yard where the passenger cars are kept is piped throughout with air and steam, and every known facility is provided for keeping the cars in good order. They look remarkably uniform in their clean brightness. We have never examined a whole yard of passenger cars that looked so well.

BOILER-MAKING—II.

By C. E. Fourness.*

BOILER SEAMS.

Figs. 1 to 10 showed ordinary single and double riveted seams, and to find the percentage of strength in these to the solid iron, some very simple formulæ or rules are applicable. For instance, find the per cent. of strength to the solid iron in a single-riveted seam, $\frac{1}{4}$-in. plate, $\frac{5}{8}$-in. rivets, pitched or spaced 2-in. centers. First reduce all to a decimal form, as it simplifies the calculation: $\frac{1}{4}$ equals .25, and $\frac{5}{8}$-in. rivets will require an $\frac{11}{16}$-in. hole—this hole is supposed to be filled by the rivet after driving, consequently that diameter is used in the calculation—$\frac{11}{16}$-in. equals .6875. First find the per cent. of strength of the sheet. The formula is $\frac{P-D}{P}=\%$, P=the pitch, D=the diameter of the rivet hole, $\%$=per cent. of strength to the solid iron. Substituting values, $\frac{2-.6875}{2}=.66$. The rule for obtaining this result is: From the pitch to subtract the diameter of the

TABLE No 2.

SHEARING STRENGTH OF RIVETS.

DIAMETER OF RIVET	3/8"	7/16"	1/2"	9/16"	5/8"
SHEARING STRENGTH	6763	8833	11182	13806	16704
DIAMETER OF RIVET	11/16	3/4"	13/16	7/8	15/16
SHEARING STRENGTH	19876	23332	27058	31063	35343
DIAMETER OF RIVET	1"	1 1/16	1 1/8	1 3/16	1 1/4"
SHEARING STRENGTH	39897	44730	49837	54900	60885
DIAMETER OF RIVET	1 5/16"	1 3/8"	1 7/16	1 1/2"	
SHEARING STRENGTH	66600	73035	79200	86287	

rivet hole, then divide by the pitch, equals the per cent. of joint. Example: $2-.6875\div2=.66$. Now for the rivets. This formula is $\frac{N\times A}{P\times T}=\%$, N=the number of rows of rivets, A=the area of the rivet hole (the area of an $\frac{11}{16}$-in. hole being .3712), P=the pitch, and T=the thickness of the sheet. Substituting values, $\frac{1\times.3712}{2\times.25}=.69$. The rule for this is the number of rows of rivets times the area of the rivet hole, divided by the pitch times the thickness of the material in the shell. Example: $(1\times.3712)\div(2\times.25)=.69$.

I would state that this formula and rule for the rivets give a higher shearing strength to the rivets than advisable for iron rivets in a steel sheet, it being 53,252 lbs. per square inch, where 45,000 lbs. per square inch is plenty high. Table No. 2 will give the shearing strength of iron rivets from $\frac{3}{8}$-in. up to and including $1\frac{1}{2}$-in., which, I think, will cover all that will be needed for some time. Remember, these values will be figured from the diameter of the rivet hole, or the driven rivet $\frac{1}{16}$-in. larger than the rivet previous to driving. These values are secured by multiplying the area of the hole by 45,000. For example, find the shearing strain of a $\frac{5}{8}$-in. rivet. The area of an $\frac{11}{16}$-in. hole (or driven rivet) is .3712; $.3712\times45{,}000=16{,}704$ lbs.

This table is convenient when figuring on any form of seams, braces, etc., and can be used where the first formula and rule could not be used. Figs. 11 to 14 show four different forms of straight seam, and the per cent. of strength in these seams will be found by a method that can be used for any seam. Fig. 11 will now be considered. The rivets are pitched $3\frac{1}{2}$ in., consequently a section of the seam $3\frac{1}{2}$ in. long will be taken as a unit to work from. This is a triple-riveted seam, $\frac{3}{4}$-in. rivets pitched $3\frac{1}{2}$ in., in $\frac{3}{8}$-in. steel having a tensile strength of 55,000 lbs. per square in. First reduce the common fractions to their decimal equivalent. The $\frac{3}{4}$-in. rivet requires a $\frac{13}{16}$-in. rivet hole; $\frac{13}{16}=.8125$, and $3\frac{1}{2}=3.5$, and $\frac{3}{8}=.375$. This joint would fail in one of two different ways—by fracture of the sheet through either one of the outside rows of rivet holes, or by shearing off the rivets.

The strength of the solid sheet $3\frac{1}{2}$ in. long is $3.5\times.375\times55{,}000=72{,}187$

The strength of the sheet, minus the diameter of the rivet hole,

$(3.5-.8125)\times.375\times55{,}000=55{,}429$

The shearing strength of three rivets, as there are four halves and one whole rivet exposed to single shear, referring to Table No. 2, it requires 23,332 lbs. to shear one $\frac{3}{4}$-in. rivet,

$3\times23{,}332=69{,}996$

The sheet through the rivet holes is the weakest; consequently divide that strength by the strength of the solid sheet for the percentage of strength of the joint or seam: $55{,}429\div72{,}187=0.767$ per cent.

Fig. 12 is a double-riveted seam of $\frac{3}{4}$-in. rivets in $\frac{3}{8}$-in. plate of 55,000 lbs. tensile strength, with an offset strip of $\frac{3}{8}$-in. plate on the inside, wide enough to take a row of rivets on each side of the main seam; the rivets in these outside rows to be pitched twice the distance apart of the others. This seam might fail in one of three different ways: First, by fracture of the sheet through AA; second, by fracture through the sheet BB, and shearing one rivet AA; third, by shearing all the rivets exposed. A section $6\frac{1}{2}$ in. long will be considered:

Strength of the solid sheet,

$6.5\times.375\times55{,}000=134{,}062$

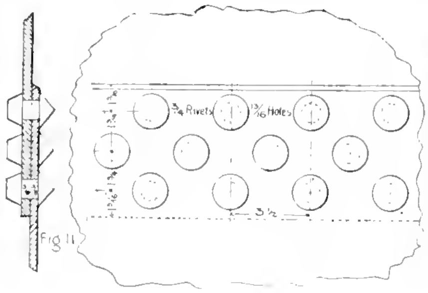
Strength of the plate through AA,

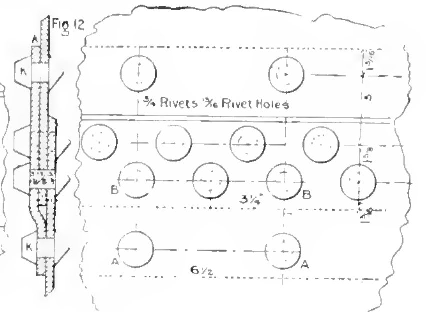
$(6.5-.8125)\times.375\times55{,}000=117{,}304$

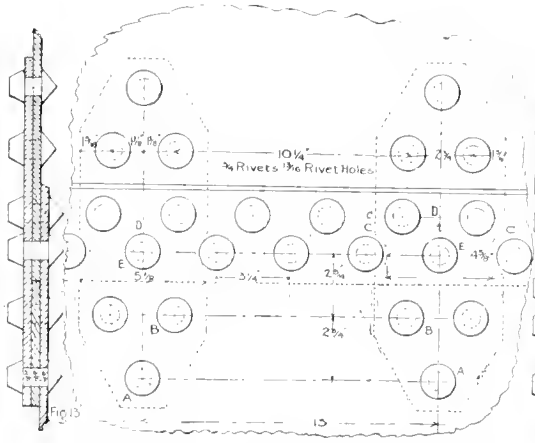
Strength of the plate through BB, and add the shearing strength of one rivet, as two halves are exposed at A and A, $(6.5-2\times.8125)\times.375\times55{,}000+23{,}332=123{,}879$

Shearing strength of five rivets, as four halves and three whole rivets are exposed, $5\times23{,}332=116{,}662$

The rivets being the weakest, divide their strength by the strength of the solid sheet, $116{,}662-134{,}062=.87$ per cent.







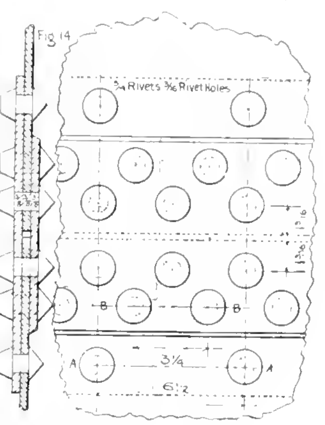


Fig. 13 is a double-riveted seam of $\frac{3}{4}$-in. rivets in $\frac{3}{8}$-in. plate, with a welt $5\frac{1}{8}$ in. wide, of $\frac{3}{8}$-in. plate, placed 13 in. apart, and the same distance from the girt seams. This seam might fail in one of five different ways: First, by fracture through AA; second, by fracture through BB, and shearing one rivet AA; third, by fracture through EE, and shearing three rivets BB and AA; fourth, by fracture through the sheet and welt DD; fifth, by shearing all the rivets exposed. A section of the seam 13 inches long, or from center to center of the welts,

* Foreman Boiler-maker, C., M. & St. P. Ry., Dubuque, Iowa.

will be under consideration; $5\frac{1}{8}$ expressed decimally, equals 5.125:

Strength of the solid plate,

$13 \times .375 \times 55,000 = 268,125$

1st. Strength of the plate through AA, $(13 - .8125) \times .375 \times 55,000 = 251,367$

2d. Strength of the plate through BB, with the shearing strength of one rivet added, $(13 - 2 \times .8125) \times .375 \times 55,000 + 23,332 = 257,941$

3d. Strength of the plate through EE, with the shearing strength of two rivets at BB and one at AA added, $(13 - 4 \times .8125) \times .375 \times 55,000 + 3 \times 23,332 = 271,089$

4th. Strength of the plate through DD, with welt added, $(13 - 4 \times .8125) + (5.125 - 2 \times .8125) \times .375 \times 55,000 = 252,656$

5th. Shearing strength of eleven rivets, single shear, $11 \times 23,332 = 256,652$

The sheet through AA being the weakest, divide 251,367 by $268,125 = 0.937$ per cent.

Fig. 14 is a triple-riveted double-butt strapped seam of $\frac{3}{4}$-in. rivets and $\frac{3}{8}$-in. steel plates. This might fail in one of three different ways: First, by the sheet failing through AA; second, the sheet failing through BB, and shearing one rivet AA; third, by shearing all the rivets exposed. A section of this seam $6\frac{1}{2}$ in. long will be considered:

Strength of the solid plate,

$6.5 \times .375 \times 55,000 = 134,062$

1st. Strength of the plate through AA $(6.5 - .8125) \times .375 \times 55,000 = 117,304$

2d. Strength of the plate through BB, with the shearing strength of one rivet added, $(6.5 - 2 \times .8125) \times .375 \times 55,000 + 23,332 = 123,879$

3d. Shearing strength of four rivets in double shear, which is two times the strength in single shear, and add one rivet in single shear, $2 \times 23,332 = 46,664 \times 4 = 186,656 + 23,332 = 209,988$

The plate through AA being the weakest, divide that strength by the strength of the solid sheet, $117,304 \div 134,062 = 0.875$.

New Cam Valve Motion.

The numerous engineers and inventors who have labored, dreamed and speculated on the production of a mechanism which would quicken the action of engine valves for the purpose of admission, cut-off and release, will be interested in an invention described by Mr. Charles T. Porter in a paper read at the last meeting of the Society of Mechanical Engineers. The motion is of the cam variety, and appears to be so ingeniously designed that the well-known weaknesses of the cam as an actuating motion have been overcome. The advantages claimed for this motion are:

1st. It imparts to the valves an opening movement, for steam admission, which, cutting off at two-tenths of the stroke, is three and one-third times larger than that given by an eccentric of the same throw. This advantage, of course, diminishes as the point of cut-off is carried later. Cutting off at four-tenths of the stroke, the opening made by the cam for admission is twice as wide as that made by the eccentric.

2d. It permits the expansion to continue, in all cases, to eleven-twelfths of the stroke, compression taking place at the same point of the return stroke. These points may be varied somewhat, by giving exhaust lead or lap to the valves.

3d. It compensates for the inequalities in piston motion which are produced by the angular vibration of the connecting rod, making the point of cut-off the same on the opposite strokes, and giving at the back end of the cylinder the greater lead and wider opening for admission, which are required by the more rapid motion of the piston at that end of its stroke.

As a consequence of the larger opening, the cam enables perfect steam distribution to be made, at high piston speed, by the use of comparatively small valves, the same valve performing the functions of admission, cut-off and release, and making a single opening for admission and a single opening for release. This gives extreme simplicity of construction, which enables the waste room to be reduced to from $1\frac{1}{2}$ per cent. to 2 per cent. of the piston displacement, for a piston travel of 750 feet per minute.

The motion is intended to be used for triple expansion and similar engines, and the claim is made that by its use the ratio of expansion of the steam can be greatly increased without difficulty.

The motion produces what seems to be an ideal indicator diagram. Those who might be ambitious to apply the motion to locomotives would, however, do well to investigate the practical effect of valve motions that have succeeded in making locomotives produce diagrams approaching those of high-class automatic engines. In every case the consumption of steam has been increased. There appears to be a good deal of truth in the maxim that, for locomotives, expansive working is expensive working.

Why the Engines Slowed.

BY SAM SHORT.

They were talking about the fearful loss of life at sea during the terrible storms of last winter, and of the *Elbe* going to the bottom, with the greater part of her human cargo a few minutes after being struck. All agreed that railroading, with all its drawbacks, was ahead of a seafaring life.

"I always thought," said the Treasurer, "that there was something in the remark of the colored cook who had seen service in steamers as well as in dining cars. 'I'se tek de lan' ebery time,' said this dusky philosopher. 'Ef you'se in a hin' en' collision an get mashed up, dar you is, you'se all dar, but when you gets mashed at sea, whar es you? You'se no whar.'"

"To tell the truth," said the Old Member, with a far-away look in his eyes, "it's a surprise to me that collisions at sea are not more common than they are.

"The thing is hardly credible, but there are lots of vessels trading in European seas that go without lights at night to save the miserable little cost of oil. It is hard gaging the meanness of some skippers. And then the keeping of watch at night is very much of a farce on ships that are undermanned.

"An incident of my own experience will let you know the kind of lookout kept on some ships. In my youth I was a marine engineer for a few years, and the greater part of my experience was on what are called tramp steamers. I shipped on one of these at Glasgow as chief engineer, and we left the harbor about 10 o'clock on a Saturday night. I have always been a temperance man, and so I was sober; but I really believe that I was the only person on board who was not loaded more or less with whisky. I had the hardest job in my experience to find firemen not too drunk for shoveling coal.

"There were only two engineers, and I kept the first watch. About two in the morning I got the other engineer down, and I turned in. It seemed that I had only got comfortably asleep, when one of the firemen came and called me. He said that the engineer on watch was so sound asleep that they could not waken him, and there seemed to be something wrong with the engines. I got up in a hurry and went below. The engineer had evidently got a new supply of liquid enjoyment after he went on watch, and it had made him oblivious to engines and all other things earthly. He was certainly asleep, and dead drunk at that. There was plenty of water in the boilers and the steam was all right, but the engines were working very slow. I felt all the bearings, thinking there must be something hot enough to slow down the engines; but the bearings were all cool, the throttle was open, and the cut-off set right. There was no reason why the engines should not be going at full speed.

"Badly puzzled about what was the matter, I went on deck. The night was dark, and there appeared to be no one on deck or on the bridge. I went forward to see if there was any one keeping a lookout forward. There was nobody there, but on looking over the bows I saw the white beach below. The vessel was aground, and the engines were doing their best to push the ship into the country.

"I went and called the captain, who had been the fullest of all the crowd. After hard work, I got him on deck and to a realizing sense of the situation.

"'Back her off!' he shouted.

"'Not much,' I said; 'not till you find out that there is not a hole in her bottom.'

"An examination was made, and no leak being found, we backed the engines, and she came off easily. Then we went on our voyage."

A Railroad Lyceum.

BY SAM SHORT.

Junction is a small railroad town, which owes its existence to the railroad shops, where 300 men are employed. When the shops were located at Junction, land speculators at once perceived the opportunity for making money by working up a boom in town lots. Predictions were made that the place would be a new St. Paul, and not a few people invested hard-saved earnings in lots that are now cow pastures. There were no natural advantages to bring forth a crowded city out of a wilderness—no water power, no minerals; only a level country, where yards could be made at little expense, and where a good, healthy site was found for the repair shops.

After the preliminary boom exhausted itself, the place settled down to natural growth, and has now about 7,000 inhabitants.

The shops were no sooner in running order, and the human attachments settled in homes, than the universal hunger for amusement began to be felt. The little world of Junction soon set about to amuse itself after the fashion set by larger communities. The boys formed ball clubs; the girls had their musical circles; there were progressive euchre clubs, and whist clubs, dancing societies, dramatic unions, and numerous other combinations calculated to lighten the passing hours and to drive dull care away.

Weariness was chased away for several seasons by these methods for time-killing. Other means of amusement were resorted to, but it dawned upon some of the people that the pursuit of mere amusement was a profitless way of spending hours of leisure. When Morris Chase, who runs the large wheel lathe, proposed that they should form an Engineering Lyceum, his words fell on fertile ground. Morris is given to high-sounding words, and his proposal, when boiled down, was to form evening classes for the study of engineering subjects.

Men and boys took readily to the new scheme, most of them had been reading railroad and mechanical papers, and an impression was abroad that some study was necessary for those who wanted to keep up with the procession. The growing practice of making men go through an examination before giving them employment or promotion, is making railroad men of all classes familiar with the idea that learning things relating to the principles of their calling is becoming a necessity.

There was no difficulty in getting members to join the Lyceum, but it was not so easy finding competent men for teachers. It looked as if the project was stalled for want of teachers, when Philip Rasbach, the draughtsman, volunteered to teach drawing. Then Archie McPherson, the pattern-maker, offered to help out with arithmetic and mechanical calculations. The Lyceum was started with these two classes, and then William Kinvig, the general foreman, who is an engineering school graduate, was prevailed upon to give instruction in applied mechanics.

The officers of the company agreed to give the use of a room in the office building as a class-room. The air-brake instruction car generally stands on a spur track near the offices. At regular intervals the whole of the members of the classes adjourn to the air-brake car and listen to Traveling Engineer Matthew talk about air-brake mechanism, lubricator construction, action of injectors, details of the heating apparatus, and kindred subjects on which he is authority, and has the mechanism at hand for explanation.

The zeal for learning soon languished. Many who joined the Lyceum when it was founded dropped out. These expected to acquire knowledge without working for it. But the select few remained—enough of them to make up good working classes—and the members are making substantial progress. Those who belong to the classes will gradually acquire information about the principles of their business which, in after years, will commend the possessors to higher positions.

One day I visited the shops at Junction, and the master mechanic invited me to visit the Lyceum in the evening. He is naturally proud of the interest the men and boys take in the classes.

PULLEY BLOCKS.

The night of my visit, the subject before the applied mechanics class was pulley blocks. The classes are carried on in a rather free and easy style, the members being encouraged to ask questions about anything they do not understand connected with their work.

The subject of pulley blocks was brought up through one of these questions. There had been a wreck on the road a short time before, with an engine down the bank, and James Palmer, the inquisitive apprentice, was out with the wrecking gang. They used a rope and snatch block for hauling up the wrecked engine, and Palmer had much to say about the immense increase of power exerted by the snatch block.

In his talk, which was illustrated by drawings and pulleys, Kinvig went on: "The pulley block is one of the six mechanical powers that every mechanic is constantly employing in some form. The others are the lever, the wheel and axle, the wedge, the inclined plane and the screw. All the mechanical powers are made up from two elements, the lever and the inclined plane. A single-movement pulley is merely a simple lever with movable arms. The pulley provides us with the most striking illustration of what in mechanics is known as the principle of virtual velocities. This principle is 'What is gained in power is lost in speed.' You find the principle applied at every step in the machine shop, from the simple pinch bar to the gearing of the punching machine.

"Every boy who rides a see-saw on a fence gets a practical lesson in virtual velocities, if he is observing enough to learn it. If one boy is heavier than the other, in order to balance he has to sit closer to the bearing (fulcrum) than the other boy, and he moves a shorter distance through the air. If one boy is twice the weight of the other, he will balance at half the distance of the other boy from the fence, and he will move through the air only half the space made by the light boy and at half the speed. The ratio of speed is as two is to one. This proportion between speed and the work done is of much importance in figuring on pulleys and other mechanical powers, and it is known as 'velocity ratio.'

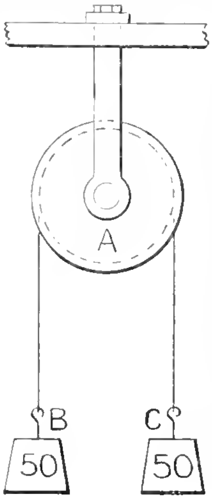


FIG. 1.

"Getting back to pulleys, the simplest form is the single-movement pulley, shown on Fig. 1. The snatch block belongs to this order of pulleys. When the weights *B* and *C* attached to the rope of this pulley are equal, they will balance each other. In the case shown there is a weight of 50 pounds at each end. This puts 100 pounds weight upon the pulley. If you pull down the weight *B*, the weight *C* ascends the same distance as *B* goes down, so the velocity ratio is equal. When this kind of pulley is used alone, its purpose is to change the direction of motion."

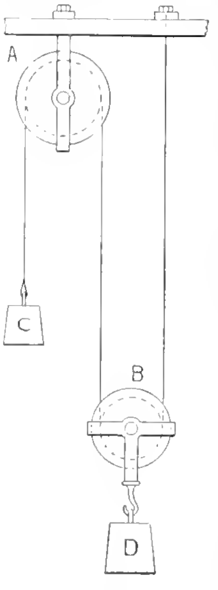


FIG. 2.

"That seems plain enough," remarked Matthew, "but why do we sometimes see a single pulley hung above machine tools, for the machinist to use in raising work?"

"That is done for convenience," replied Kinvig, "and it really enables a man to lift a heavier weight than he could raise in his arms. You see, with the pulley he can get a direct pull on anything he wishes to lift. You all know that you can stand directly over a heavy axle-box and raise it from the ground. When you try to take the same box in your arms and lift it to a planer table, you find that you can't do it. When it is held in the arms, the leverage is against you.

"The snatch block is used for the same

reason as they place a single pulley block above a tool. An engine is down a bank, and the wreck-master wishes to haul it in the direction of least resistance, or by the way that it can be drawn back to the track with the least labor. The locomotive or wrecking-car engine used to supply the power cannot be put in a position to pull directly upon the wrecked engine, so a snatch block is anchored in the right position, and through it the force to do the hauling is transmitted in the direction required."

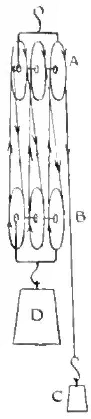


FIG. 3.

"Why would a strong ring not be as good as the snatch block or the single pulley?" asked Palmer.

"That brings up a question of friction," replied Kinvig. "There are two kinds of friction which we are all very familiar with in shop and railroad work. When you roll a pair of wheels on the rails they are easily moved, but if you try to slide them a great deal of strength must be exerted. One is a case of rolling friction, the other is sliding friction. A rope passed over a pulley that revolves, moves by rolling friction; when a rope is moved over a bar or through a ring, it has to be moved by sliding friction. In the latter case the work lost in friction is very great.

"We all know that a wheel can be rolled much easier than it can be slid," said Palmer, "but a flexible thing like a rope sliding over a solid bar ought not to give much greater resistance than it does rolling over a pulley.

"That is where you are wrong," replied Kinvig. "I will show you the difference by experiment in the machine shop next lesson night. At present, you have to take my word for the friction under the two conditions.

"With large, well-made pulley blocks, the loss from friction is very small. Within certain limits, the larger the sheave of a pulley block the smaller is the work lost in friction. The work lost in friction with a single pulley block varies from 3½ to 5 per cent. The amount of friction increases directly with the load. That is to say, 3½ pounds will overcome the friction when the load is 100 pounds, and it will take 7 pounds to produce movement when the load is 200 pounds.


FIG. 4.

"Returning to the example of Fig. 1, you will find that a pull of 3½ pounds added to the weight *C* will make it descend and raise *B*. Now, if we take the rope out of the pulley block and put it over a hook or plain bar, we will find that more than three times the weight to be lifted must be exerted before movement begins. In fact, instead of starting movement by the addition of 3½ pounds to one weight, it will not move until an addition of about 120 pounds has been put on."

"That is all very strange," exclaimed Palmer. "The block that I thought increased the power decreases it. Tell us, anyhow, in what way increase of power is got from using pulley blocks."

"It is just on the same principle that increase of power is got from many of the shop tools you are familiar with. You reduce speed and gain power. The same thing is seen in locomotives. We have 20 x 24 passenger engines with driving wheels 72 inches diameter—they are flyers, but they are not worth much on a hard pull. We have moguls with 20 x 24-inch cylinders and 50-inch wheels—they are not flyers, but they haul twenty-six loads over Morse Hill.

"In Fig. 2 you see a double-block arrangement. A weight of 100 pounds hangs on the movable pulley *B*. If we could ignore friction and the weight of the pulley *B* and the weight of the rope, a weight of 50 pounds at *C* would exactly balance the weight of 100 pounds. In this case the friction is about 10 per cent. When weight sufficient is added to cause the weight *C* to raise the weight *B*, the power, as the light weight is called, moves two inches down for every inch the load *D* goes up. Thus the speed ratio is 2 to 1.

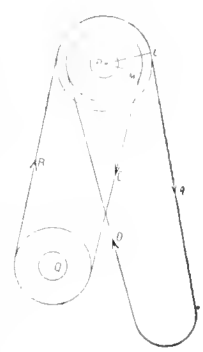


FIG. 5.

"The kind of block and tackle mostly used in wrecking and other outside work are the double three-sheave pulley blocks shown in Fig. 3. A rope is fastened to the upper block *A*, and then passes round a sheave of the lower block *B*, and up again to the upper block, and so on till the rope passes over all the sheaves. If there were no friction, the rope passing through these blocks would balance six pounds of load to one of power. About one-third of the power in this case is lost by friction. The speed ratio is 6 to 1."

"That talk is very interesting and instructive to me," said Matthew, "but there is one hoisting apparatus used a great deal in the shop which I, for one, do not understand. That is the Weston differential pulley block. It has only three pulleys, but it can be made to lift more weight than a set of six sheave-blocks. How is it done?"

"The differential pulley block," answered Kinvig, "is a development of the Chinese windlass, used in many draw-wells, and is a good illustration of the mechanical principle, so often seen in practical mechanics and already referred to, where, by sacrifice of speed, great power is obtained. In the differential pulley block, the power moves much farther than the load.

"The differential pulley block shown in Fig. 4 consists of three parts—an upper pulley block, a lower pulley block, and an endless chain. The sheave of the upper block is double, one part being a little smaller in diameter than the other. The grooves have sprockets on the edges to prevent the chain from slipping. The lower block has a single sheave.

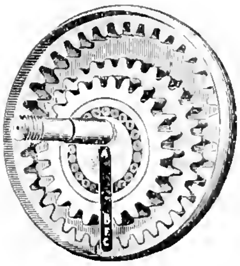


FIG. 7.

"The action of the apparatus can be readily followed in Fig. 5. The chain passes from *A* up to *L*, over the larger groove in the upper pulley; then downwards at *B*, under the lower pulley; up again at *C*, over the smaller groove in the upper pulley; and then back again by *D* to *A*. When the chain is grasped at *A* and pulled down, the two grooves of the upper pulley begin to move together. The action of the part of the chain passing over the large groove is to raise the lower pulley *O*, and the action of that part of the chain passing over the smaller groove is to lower the pulley *O*. But the large sheave being slightly greater in circumference than the small one, the load is raised in proportion to the difference in size of the sheaves. With the most common differential pulley blocks, the load is raised one foot for sixteen feet of chain hauled over the sheaves. The speed ratio is, therefore, 16 to 1.

"When the direction of the chain is reversed, the load is lowered by the large sheave and raised by the small one, so the load descends."

"But why," asked an apprentice, "does a differential hoist hold its load so that it does not drop to the floor?"


FIG. 6.

"That is due to the friction of the apparatus. While the friction of a six-sheave pulley block is about 33 per cent., the friction of a differential hoist is about 65 per cent. This seems to entail great waste of power, but the convenience of the apparatus compensates for this. Not the least merit of the hoist is that there is friction sufficient to hold the load from overhauling. When friction absorbs more than half the power applied in operating a hoist, the load may be depended upon to hang without overhauling. When the friction is less than 50 per cent., then the rope or chain must be fastened to prevent the load from overhauling."

"How do you figure the amount of friction?" asked Matthew.

"The amount of friction has been found out by experiment. If we have a weight of 100 pounds hanging to the differential block, the pull on the chain required to move the load would be one-sixteenth of one hundred if there were no friction, which is 6.25 pounds. If we take a spring balance and use it to pull the chain by, we find that the pointer goes up to about 22 pounds before the load begins to move. When the load is once in motion, it can be kept going with a pull of about 20 pounds. When we divide the theoretical power by the actual power required, thus $\frac{6.25}{20} = 31$, we find the efficiency, which is 31 per cent."

"There is a different kind of hoist in the boiler shop," remarked Chase. "How does it work?"

"That," said Kinvig, "is the Moore anti-friction differential block, which has been designed to reduce the friction that reduces the efficiency of other differential blocks. Fig. 6 shows the general arrangement of the hoist. You will see that in this the hand and lift chains are separate. This is actuated by an arrangement of gearing with a perpetual leverage, always working at its most advantageous point. Details of the movement are shown in Fig. 7. The pinion is double—that is, two sizes in one casting. Refer to the cut and note the point *A* in the center of the eccentric, the point *B* directly below it on the pitch line of the smaller pinion, and the point *C* below and in line with the other two points on the pitch line of the larger pinion—the line on which are these three points is the lever. The fulcrum is an imaginary point *F*, on the line of the lever midway between the pitch lines of the small and large pinions.

"The annulars, or internal gears, are in mesh with the two pinions (or double pinions) at points *B* and *C*, on the above named lever. The lever operates on the annulars at these points; and, since the lift chain hangs from opposite sides of these annular wheels, they are pulling in opposite directions—one on each side of the imaginary fulcrum, point *F*. Now turn the eccentric slightly, the lower part to the right; imagine the fulcrum point *F* stationary: the point *A* of the lever moves to the right; the point *B* of the lever will move in the same direction; but the point *C*, being on the other side of the fulcrum, will move in an opposite direction; the two points, *B* and *C*, necessarily carrying with them the annular or lift chain wheels, in opposite directions.

"It will readily be seen that, whatever the position of the eccentric and pinions, the relative position of this imaginary line, or lever, is always the same.

"It is rather an infinite series of levers, corresponding in number with the number of points on the pitch line of the annular wheels.

"It is apparent that the load on the block exerts through this leverage a constant pressure on the side of the eccentric, and that the block will 'run down' unless there is sufficient friction to prevent it."

The Weston Differential pulley block is made by the Yale & Towne Mfg. Co., Stamford, Conn., and the Moore Anti-Friction Differential chain pulley block by the Moore Mfg. and Foundry Co., Milwaukee, Wis.

A Convenient Freight House

The "Big Four" freight house, at Indianapolis, is well worthy of a visit from railroad men who are trying to find out the way in which a large volume of freight can be handled most expeditiously and at least cost. The freight house is a one-story building, about 1,000 feet long and 80 feet wide. Along the middle of it is a passageway for vehicles, and at each side are wide platforms on which the freight is handled. On these platforms signs are exhibited, intimating the various stations for which freight is to be taken in, as, for instance, Danville, Peoria, Terre Haute, etc. When a truckman goes in with a load of freight he delivers it at the part of the platform indicated by the destination of the freight, and all confusion of having packages for a variety of places stored together is avoided. Outside, on one side of the house, there are three tracks, with platforms between each. When cars are pushed on to these tracks, the practice is to load those on the track farthest from the house first, so that the loaders can go through the empty cars that intervene with the freight intended for the cars to be loaded. This is done with each successive track until the cars nearest the house are loaded. Of course, arrangements are made in pushing in the cars, to have them stopped opposite the points where the freight is waiting for them.

The arrangement of freight matters and yards was worked out by Mr. J. Van Winkle, general superintendent at Indianapolis, and he is always very ready to give particulars to other railroad men about his method of handling freight.

Air-Brake Instructor McKee, of the Great Northern, tells a comical story of a Swedish brakeman who came into the instruction car with a class. Just as they got into the car someone put on the emergency, and the fifty pistons went out with a noise like the rattle of a musketry charge —all hands scrambling for the door. The Swede was the first to recover his breath and nerve, and advancing in a somewhat threatening manner toward the instructor, shook his finger and said: "Look hyr, Mestir 'ir man, you tank you skar me? I no 'frad dam 'ir brak'; I ban run tresh' ma-chin' ennine, an' sit 'oop first salf bindar dis kounty, so!"

Some Principles of Design.

BY GEO. S. HODGINS.*

Some years ago, in England, the famous art critic, John Ruskin, wrote a book in which he laid down certain canons of criticism by the application of which, he maintained, works of art should be studied and judged. Some "old masters" suffered by comparison with artists of more recent date. So effective was the criticism that one writer described the book ("Modern Painters") as containing the Gospel of Art-Criticism According to St. John—Ruskin. It is said that the works of Turner were by this book raised to such a high place in the world of art, that Ruskin found that in time a painting by that artist had passed beyond his ability to purchase. Briefly, the rules of criticism amounted to this: A picture was not to be judged solely by its faultless drawing; and though it should be true to Nature, it should not be prized because of any photographic or microscopic exactitude. The first place was rather to be given to the *thought* embodied by the artist in his work—that suggestive, far-reaching quality which gives to the spectator the full and wide meaning of the artist, and reveals his correct imagination and grasp of the subject. It is the evidence of the mind, and not simply the skill of the hand, that is to be most admired.

In designing machines, or parts of a machine or working mechanism, the rules of the great art critic may not be applicable; but the fact remains that all work, whether artistic or simply useful, should be judged by a rational standard rigorously and faithfully applied, without personal leanings or bias of any kind. A good design can be distinguished from a bad design, by applying to its consideration certain rules or canons of criticism. Its excellence, or the reverse, must depend upon how nearly it conforms to correct principles.

One of the first requisites in the designing of any part of a machine or mechanism intended to sustain strains and stresses in transmitting power, is that the part designed shall be strong enough to perform its work. It should also have a margin of strength over and above that which it actually requires to withstand the pressure or resistances which it is called upon to encounter. This margin of strength is generally called the factor of safety; and the possession of this is one of the fundamental principles underlying all successful designs.

LOCOMOTIVE ENGINEERING, in the February issue, in giving a history of the early days of the steam engine, shows that by the repeated failures of these first machines, some persons were led to conclude that the old water wheel was a motor superior to the steam engine.

Very much akin to this strength of the part, as a whole, is another, which, for want of a better term, may be called strength of form. The design, when car-

* Canadian Pacific Ry., Windsor, Ont.

ried out, should produce a piece of mechanism which will receive the shocks, pushes or pulls that it is destined to meet, in such a manner that excessive and disintegrating internal stresses may not be formed which will tend to rupture it. For example, a simple bell crank, containing metal enough, and of sufficient cross section—with the required factor of safety—might be so designed, and made with such sharp edges and angles, that it would in time crack in the sharp corner and finally break. The link-lifting saddle, bolted to the expansion link of a locomotive, with pin extending outward for the lower end of the link hanger to grasp, might be strong enough to perform its function, yet might ultimately fail on account of having a sharp angle, without fillet, where pin and saddle join.

This sharp, clearly defined angle would probably be the point from which incipient cracks would radiate. A car axle, strong enough for use, might, by having a sharp angle where the wheel seat terminates and the uncovered portion leaves the inside surface of the wheel hub, be the starting point for ultimate fracture. These dangers can be avoided by giving the design strength of form. A bar of flat iron is stiffer in resistance to certain strains when placed edgewise than the same bar, or equal cross-section, would be if turned flat. Many bottom pedestal braces of car trucks are turned on edge in the center to overcome excessive vibration, which would in time cause the breakage of the iron. The duty of this strength of form would seem to be to resist and "take up" the numerous vibrations in the metal when in service, which ripple through it with a wave-like motion. An example of this action may be seen in any pond, where a sharp angle of a stone in the water will cause successive ripples to break the surface in irregular eddies, and even splashes, destroying entirely the wave-like motion. The curved surface of the same stone will throw off and reflect the ripples back, and by the phenomenon known as "interference" neutralize many, and though intensifying others, redirect them into a harmless outward line of progression.

Another requisite which the completed design should possess, is the power to resist all internal stresses produced at the time of manufacture. This "natal strength," or, literally, the strength necessary to be born, must be possessed by all parts of a machine which survive in the struggle for existence. The careful proportioning of castings of all kinds, so that cracks will not appear where large masses of metal join small, is essential. This natal strength, if it may be so named, when regarded in its widest significance, includes all strains put upon a piece of mechanism during the entire process of preparation for actual service. Thus, the strains caused in wheel and tire, when shrinking on the latter, would come within this description. The pressing of wheels on axles is another example. Both of these instances, it may be said, however, do not strictly come within the designer's province, inasmuch as a careless or ignorant workman might spoil the most carefully thought-out design. But, nevertheless, the treatment given to any piece of mechanism before it finally begins its period of service must be taken into account by the designer, because it would be possible to produce a design from which the piece of mechanism could not be made, or, if made, only at an excessive cost.

As an example of judicious design in this respect, might be cited the piston-rod fastening mentioned on page 40 of the LOCOMOTIVE ENGINEERING for January. It is used by the Schenectady Locomotive Works, and in securing the crosshead to the piston rod, the key puts a strain on the end of the rod opposite to that in which it is usually found. As a consequence, it removes the stress caused in this process of making or combining the parts, from the part of the rod which will be strained most when transmitting power in service. The groove turned in the rod close to the crosshead in this design, by reducing the diameter and permitting the rod to spring slightly when working, is probably an example of the strength of form. The choice of metal, as well as the actual design, has largely to do with the success of a working part. Though strong enough, it may, if cast, be destroyed in the cooling, mainly by its inability to cool evenly; or if it succeeds in cooling evenly and without fracture, it may do so with such enormous internal stress that, like the well-known Prince Rupert's drops, made by throwing molten glass into water, a blow, or even a scratch on the surface, may liberate the pent-up forces and destroy the piece. Cast-iron car wheels, if not carefully proportioned, often show a tendency to crack where the outside and inside plates join. This is not because they are too weak for service, but because they are unable to evenly stand the loss of heat when cooling in the mold, or the subsequent addition of heat imparted under the pressure of a brake shoe.

Simplicity is generally conceded to be a requisite, if not an essential, in any good design. Simplicity not only seeks for as few separate parts as possible, but endeavors to limit the methods of combination as far as possible. An engineer's brake valve made so that it can only be put together in one way, is an example of this more extended view of simplicity. The fewer the working parts in any design, the fewer bearing surfaces there probably will be. Fewer bearing surfaces to lubricate or portions to wear, means probably cheaper maintenance and longer life to the device. Within reasonable limits, the adjustment for wear and tear must be provided for, so that a large piece of metal need not be scrapped because only a portion of it is worn out. Many otherwise excellent designs, like the old fashioned quill pen, have to be laid aside entirely after a few mendings or adjustments for wear.

Closely allied to simplicity is accessibility. Parts of any piece of mechanism should be easy to get at to repair. The improved engineer's brake valve is an example of this kind. The working parts can be reached without disconnecting all the air pipes. Main valves in the smokebox of an old-fashioned locomotive are an example of the opposite kind. King pins and center-plate bolts passing through the floors of box cars, and draw timber bolts put through sills, below the ice-boxes of refrigerator cars, are often practically inaccessible for quick renewal.

Elegance of design, like simplicity, is an advantage, though not necessarily a requisite. The Rev. Joseph Cook, in one of his famous Boston Monday Lectures on the Masterpieces of Ancient Greece, says: "There is not a straight line in the Parthenon." That wonderful temple, erected in honor of Minerva, is everywhere formed with curves so delicate and subtile that they perform their work of beautifying, one might almost say, unseen. The slight swelling in the center of the graceful Doric columns, and the almost imperceptible curve in the line of steps, give the impression that the bold outlines of the temple are straight. Strange as it may seem, absolutely mathematical straightness would impart a poverty of form easily discernable, though the cause might be difficult to detect. Modern machinery or locomotive engines may not lend themselves readily to the beautifying touch of the æsthetic designer, nor in this utilitarian age might such design be thought even desirable. Many of the minor details of locomotive construction, however, are susceptible of much improvement in this regard. It is not more expensive, in many cases, to manufacture a beautiful object than to make one with little or no elegance.

Probably as a result of an art critic's good-humored strictures on the American stove, that most useful article of household equipment is now more often surmounted with a representation of some old Viking or ancient Saxon warrior. On the locomotive engine, the curves of the bell, or even of its stand, the shading off of straight lines into necessary curves in the outline of the sandbox or dome, are not matters of expensive outlay, but when carefully executed, are often the means of producing the effect of a graceful and well-proportioned machine. The height, size and general design of the locomotive cab may make it comely or ugly; the slope and proportion of the tender coping may add to, or detract from, the general appearance, without in any way increasing the first cost. The outline of the counterpoise of the driving wheels, or the section of the spokes, the finials, brackets, stands, castings, etc., may all be

made to a certain extent beautiful, without increasing the cost of production.

A feature of designing often overlooked, but nevertheless of much intrinsic importance, is the probable behavior of parts in case of failure in service. The safety of life and property may depend upon this matter having been carefully considered by the designer. The Laird or other forms of overhanging guide bars should have suspended from them an open "spectacle plate," through which the connecting rod could work, so that, in the event of a breakage which would free the "little end," that end of the rod would not instantly fall to the ground, but would be held up, and so give the engineer at least a chance to stop his fast-running locomotive.

In the matter of wrecks, which is but another view of the probable behavior of parts under failure, outside boiler checks, safety valves, blow-off cocks, globe valves, turrets, whistles, and, indeed, all boiler mountings unprovided with safety or protective appliances, are examples of want of foresight in this important matter. The anticipation of failure is a principle rigorously insisted upon by the M. C. B. Association in its code of rules. In the matter of cast-iron car wheels, these rules endeavor to reduce the chances of disastrous failure to a minimum, by fixing the deviation from the perfect wheel within narrow but carefully considered limits. Boiler check valves placed in the cab, on the back sheet, and communicating with the interior of the boiler by long and sometimes crooked pipes reaching well toward the smokebox end, might be classed as an objectionable design for regular service. When coated internally with scale, they are difficult, if not impossible, to clean out, and in time may reduce the effective action of the very best injectors. This example might also be placed under the head of want of accessibility.

The principle of anticipating failure may, however, be carried too far. In many cases, the rejection of knuckles for small defects in car interchange does this. The careful consideration of the matter, however, especially in the construction of locomotives and high-speed engines, is one of the utmost importance, and a correct estimate of the probable result of failure, from inherent defect or forced failure by interference from without, may have a very serious bearing upon the value of any design. Above all, where human life is menaced in any way, the thoughtful observance of this aspect of the requisites of good design should be considered obligatory by the designer before ever he takes pencil in hand.

A well-known superintendent of motive power who has good opportunities for finding out the condition of railroad machinery in the Middle States, asserts that nearly all railroads centering in Chicago are one year behind in the maintenance of cars and locomotives.

Sand Dryer, Storage and Pneumatic Delivery Apparatus.

The engraving on this page shows the general arrangements of an efficient sand-house and air-pressure delivery outfit recently erected and in use at the shops of the A., T. & S. F., at La Junta, Col.

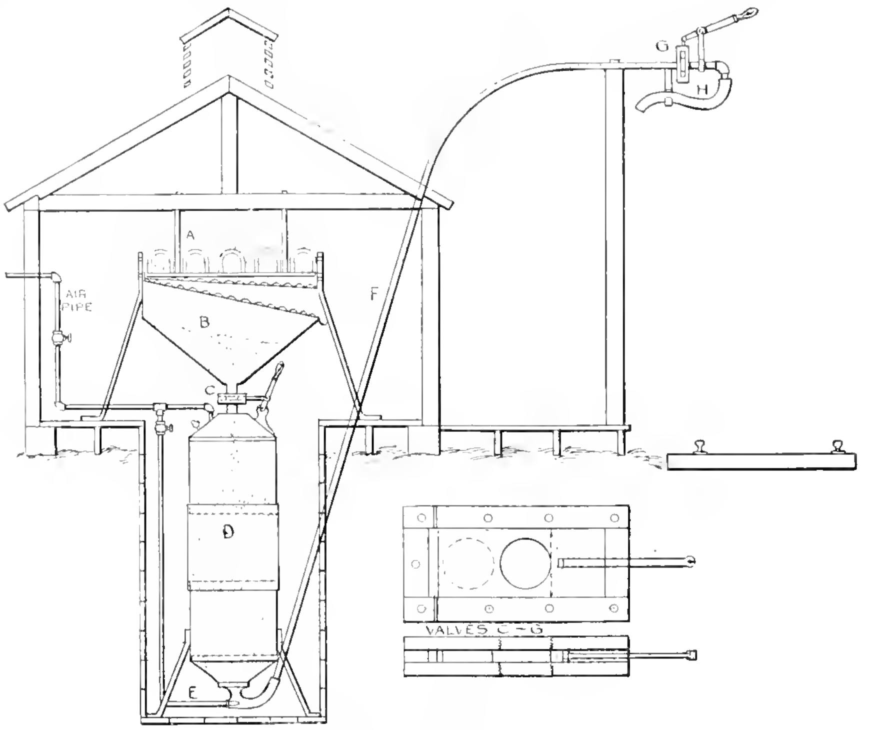
It is hardly necessary to publish a detailed description, the sketch making every detail of construction plain.

General Foreman M. J. Drury gives the following explanation:

A represents square drying box, in which are suspended coils or loops of steam pipe at sufficient incline to insure proper drainage. The bottom of the box is of $2\frac{1}{2} \times 2\frac{1}{2}$ mesh netting, trussed and suspended, admitting of a slight lateral motion to precipitate the dry sand which, in falling, passes through an intervening screen of 4×4 mesh netting set at an angle to carry off coarse gravel; the dry sand falling into hopper (*B*).

D is a round storage drum of pressure strength set in a pit cased with plank and large enough to admit passing around it. *C* is valve connecting *B* and *D*. *F* is the delivering pipe. *G* is the valve controlling flow of sand into engine sandbox.

To charge drum for operation, open release valve *X* on top of drum, relieving drum of pressure; then open slide valve *C* and fill drum with sand; close *C* and *X* and open valve in air pipe. If sand does not flow freely at first, open valve at *Y* which admits air to *E*; this acts as a primer, or a persuader, but is seldom used. *H* is a piece of hose, to lead sand into box of engine. With 80 lbs. pressure and a 2-inch pipe this device will deliver 10 cubic feet of sand per minute. With the exception of drum *D*, valves *C* and *G*, and pipe fittings, it is made of old material. A large sketch of valves *C* and *G* is also given.



PNEUMATIC SAND LIFTER.

An Engine in a Bad Fix.

Sam Hutchins, the genial president of the Air Brake Men's Association, tells a good story from his experience. One night Sam pulled the express out on the road; the engine began to limp, and soon had but three exhausts. Sam stopped and commenced to look her over, examining eccentrics, links, etc., as a careful man will. While thus employed, the conductor rushed up to find out the cause of stoppage, but Sam hadn't found the broken valve-yoke yet, and, when questioned on the point, answered:

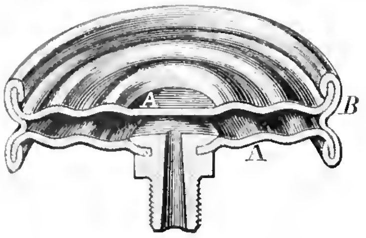
"She's lost a jewel somewhere."

The conductor knew no better, and was satisfied; so at the next station he telegraphed the valuable information to headquarters. The trainmaster was stumped, too, and came out to the engine the next day to have Sam show him where an engine's "jewels" were located.

At the Columbus, O., shops of the Panhandle they make all their large milling cutters, reamers, rose bits, etc., of wrought iron and case-harden them. They have given the matter of small tools a great deal of attention at these shops. These tools do as hard and heavy work as any steel ones, and can be more easily made, and in forms that it is almost impossible to harden in steel. It is worth a trial anywhere.

Bourdon vs. Others.

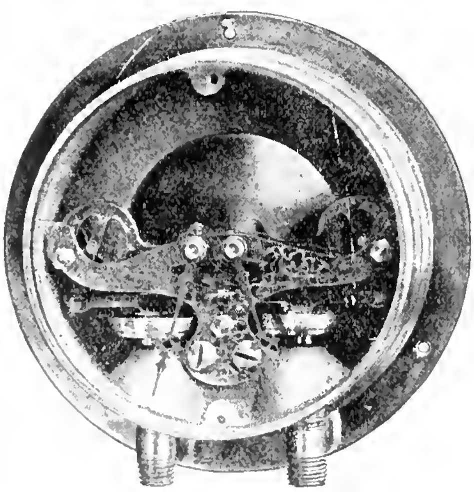
In the early history of pressure gages there were two types of spring known as the Bourdon tube and the Diaphragm. The latter being first made in flattened disk form bolted or fastened rigidly at the circumference, motion applied at the center of such a design caused an effort at



Hinged Diaphragm.

corresponding lessening of the diameter. (Cut a strip of paper and fasten the two ends tightly to a board; now lift the center.) Rigid bolting at the circumference, working against natural laws, produced a fractured head. The next move was to corrugate the head, which, although an improvement, did not stop the trouble; it merely postponed the fracture. About this time the secret (a simple one) was discovered by E. A. Wood, of Utica, N. Y., who overcame the trouble by flanging the circumference of the heads and fastening at a point which acted *as a hinge*, and locking the heads in an elastic band—a radical departure.

This capsule spring, being circular in form, has, by over-zealous competitors, been called one of the old diaphragm class. The Bourdon tube originated in Europe, subsequently being adopted by many gage-makers in America who had been obliged to abandon their diaphragm gages. Mr. Woods' patent was the founda-



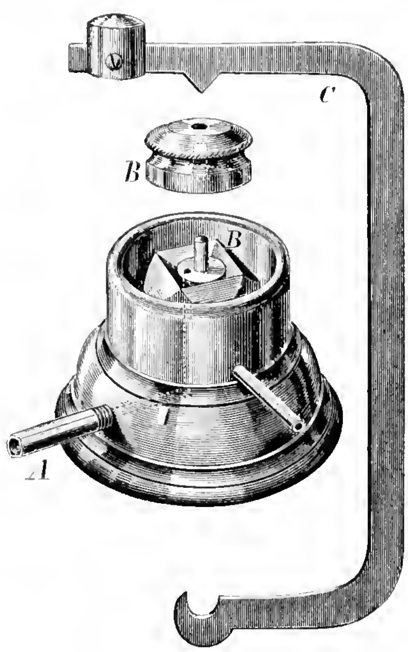
Interior Double Gage.

tion of the Utica gage, and thirty years' use has proved its durability and accuracy. The Utica Steam Gage Co., 70–72 Fayette street, Utica, N. Y., controlled this patent, as well as subsequent improvements in process of manufacture, and they inform us that some of these gages have been received after being in constant use twenty-five years, and found on test to be as accurate as a new gage.

The Utica people inform us that they are now turning out a gage movement to run on centers, making it most accurate and at same time rigid and durable, reducing all friction to the minimum. We have secured cuts from the Utica Company of several of their productions which we know will be interesting. The standard locomotive gage is known as their No. 6, graduated usually to 260 lbs.; back flange measures $8\frac{1}{2}$ in. diameter.

THE UTICA AIR-BRAKE GAGE.

This gage is designed to show the pressure on train line, and at the same time the pressure in the reservoir. It is virtually two gages in one, each hand being operated by a distinct and separate pressure, and there is no confusion of hands, even at night. It is not necessary to distinguish between a red hand and a black one



Test Valve.

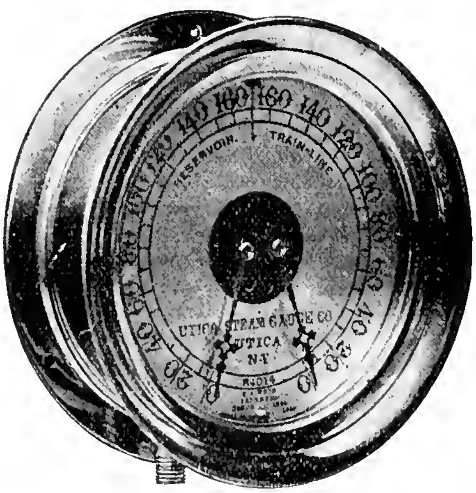
in the uncertain light in a locomotive cab, and no large center bearing is necessary, as is the case where one spindle passes through the other one. The center spindle should be the most delicate bearing in the whole gage, as the slightest friction at this point would impair its accuracy. The size is standard, $6\frac{1}{4}$ in. diameter of back flange, and it has a 5-in. dial and is $2\frac{1}{2}$ in. deep over all.

UTICA TEST PUMP AND VALVE.

The Utica test gage and pump is here shown in combination with a gage and a square inch valve. It works with a screw, and has no valves; is made wholly of steam metal, and neatly mounted on black walnut stand. The engraving also shows the way in which the test valve may be connected with any force pump. In the cut it is shown with the weighted yoke in place. This valve consists of a brass base, provided with a pipe *A*, to be connected with a pump. At *B* is a hardened steel valve and seat, the latter having knife edges for the valve to rest upon, and being made exactly 1 square inch in area. The valve is guided by a guide stem in the seat. The water pipe *A* opens directly under the valve, as shown by the dotted lines. The valve, when in place, makes a tight joint with the knife edges, and the pressure be-

Standard Steam Gage.

neath is confined until it exactly balances the combined weight of the valve, yoke *C* (which rests by a pointed projection on the valve), and any extra weight which may be suspended from the lower hook of the yoke. With this the accuracy of a gage, at any specified point of its registry, can be ascertained. Its action is certain and convincing, and its results as accurate as the scales used for weighing its load. By turning the wheel the water is forced into the test gage *E* and beneath the valve, and also in the gage to be tested, which is placed at *F*. The pieces of iron attached to the yoke have been previously



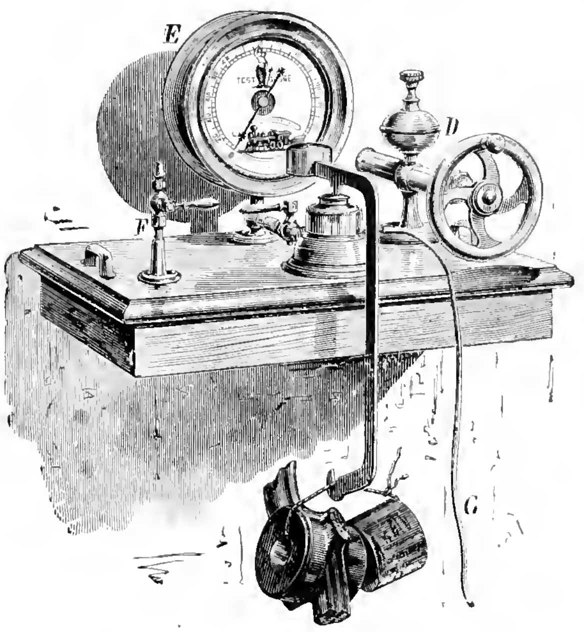
Double Air Gage.

weighed, so that the valve must lift and the water escape by the overflow pipe *G* the moment such known weight is exceeded by the water pressure. The gage or gages should then indicate a pressure per square inch equal to the combined weight of the *valve, yoke and weight attached to the valve.*

The Confusion of Wire Gages.

One of the most important subjects which will be reported on and discussed at the Master Mechanics' Convention is "Gages for Sheet Metal, Tubes and Wire." There is so much confusion with the existing diversity of gages for distinguishing the thickness of these things, that the engineering societies of the country will confer substantial benefits upon the trades interested if they can lead to the adoption of a uniform system of measurement. A committee of the American Society of Mechanical Engineers is co-operating with the committee from the Railway Master Mechanics' Association in this matter, and it is understood that the same report and recommendations will be submitted to both organizations.

There has been a great deal of tinkering with wire gages in the last twenty-five years, and every change has brought increased confusion. "Chordal," writing to the *American Machinist* fifteen years ago on this subject, says: "My own personal objection to the wire gage is its existence. The object of gaging anything is to ascertain some dimension. The dimension wanted is invariably expressible instantly in standard units of dimension, but the awkwardness of trade has buried the sweet simplicity of gaging under a cloud of technical 'numbers' which don't express anything at all. To say that a piece of wire is No. 7 does not give any direct idea of size, which is the only thing we want to know. The only information such an expression gives us is, that the wire fits in some notch somewhere, and that notch is yclept No. 7. To find out how big the wire is you have simply to measure the notch. If the notch is hard to measure, or there is doubt about the notch fitting just right, the approximate size of the notch may be arrived at by measuring the wire. All very simple.



TEST PUMP AND VALVE.

"The whole plan of giving numbers to things whose dimensions might as well be given right out in meeting is humbug. A No. 7 wire isn't the same as a No. 7 boot, and there is no way of finding the size sought for without being able to figure on what notch the wire or the boot is said to fit. Why not say a No. 6 barrel, or a No. 4 dose of medicine, or a No. 9 mule, or a No. 14 locomotive, or a No. 13½ greenback—meaning thereby $10, or a No. 12 diamond, or a No. 8 journey, or a No. 7 postage stamp, or a No. 3 cheese, or a No. 10 pile of coal?

"Imagine a brakeman yelling out 'Cairo No. 11 for refreshments.' All of this system of numbering could be easily carried out, and be a great deal handier than the present system of wire gages.

"The practical difficulties in the way of such systems would make them a nuisance, just as the wire gage is now. When you write to a man to know how big a certain wire is, it is presumed that you want to know just what you ask; that is, how big the wire is. In reply you are generally told that it will fit tolerably nice, or scant, or full, in a certain hole marked No. 14.

"If you don't care much, this may satisfy you. If you care a little about the matter, you had better send for the identical hole referred to. If you care very much, you will send for a sample of the wire.

"From the looks of things, one would suppose that in the year 1 some man made the first piece of wire and filed a notch to fit it. After being some time in business, he had made several sizes of wire and had filed several notches. Then these notches were numbered and became the happy standard of an intelligent people. Nobody knew the dimensions of these wires, or these notches, and probably there was then no particular reason for caring. After awhile somebody wanted wire which would not fit any of these notches. Here was trouble in the camp. What business had any man to want anything which would not fit any of the holes? In obedience to the law of progress, the wire gage was overhauled and new notches to fit new wire, which had been made, were added, and all were renumbered. The new gage we will suppose was 'adopted.' Now, it is much easier to universally adopt a new thing than to universally throw away an old thing, and as a consequence there were two gages in use early in the game. Then troublesome customers got more odd sizes, and new gages were adopted, and even to-day there are in use in wire and sheet mills, gages bearing the following names: Birmingham, Stubs, Washburn & Moen, American, Brown & Sharp, Trenton Iron Co., Standard, Music Wire, Steel Wire, G. W. Prentiss and English."

Etching Iron and Steel.

We have had several inquiries lately about how the etching of iron and steel is done to make prints that will show the structure of the metal. There are a variety of mixtures in use for etching, and every engineer doing this kind of work will likely use the mixture that suits him best.

We have, however, examined a variety of etching work done by Mr. T. A. Lawes, M. E., of the "Big Four" at Indianapolis, which induced us to ask for a description of his mixture and his method. In answer to a letter on this subject, he says: "A section of the piece to be etched is turned or ground to a true surface and polished with emery cloth. This surface, free from grease, is dipped into the following mixture: Water, 9 parts; sulphuric acid, 3 parts; muriatic acid, 1 part.

"The action is allowed to continue until either the soft parts are sufficiently dissolved, so that a ridged surface results, or until no ridges whatever develop. Should the action be slow, we would apply a mild heat—a porcelain dish is preferable, although a glass dish answers fairly well. In mixing the etching fluid, add the sulphuric acid to the water and the muriatic acid to this mixture. Iron will show a ridged surface, while steel will show a homogeneous surface. Don't be alarmed if the mixture etches slowly—sometimes we are at it for twelve hours."

The Lake Superior Transfer & Terminal Co., at West Superior, Wis., have seven heavy Schenectady switchers that are kept cleaner than nine-tenths of the passenger engines in the country. Peter Riley, the general foreman, has a small roundhouse that he fitted up himself. It is colder than "Greenland's icy mountains" at West Superior, and Riley fitted up a novel heater arrangement for his house. He ran loops of piping between each stall and around the house in plentiful supply; to this system he coupled the steam-heat hose from a live engine and let her do the heating. The pipe system has a safety valve that prevents a pressure of over 40 pounds. From this pipe system there can be made a connection to the blower of any engine in the house, to assist in raising steam.

We have received a very handsome souvenir book issued by the grand office of the Brotherhood of Trainmen, at Galesburg, Ill. Part of the book is devoted to half-tone illustrations of their printing office. This is the only one of the orders having a complete plant of its own, and we should judge it was a good one.

Tubes as Boiler Stays.

A notice which we published a few months ago, telling about the improvement effected in preventing leaky tubes, which had resulted from a strong stay being placed between the tube sheets, about the middle of the tubes, has brought us intimations from correspondents that the practice is followed on several railroads. Anything which will lessen the annoyance and expense caused by leaky tubes deserve to be universally known. To leave out a tube and put in its place a strong stay, which will carry the principal strain of keeping the tube sheets parallel, is such an easy and inexpensive operation that every master mechanic troubled with leaky tubes ought to try it.

The high steam pressure, becoming every day higher, makes it highly important that every detail of boiler construction should receive unflagging, intelligent attention. The staying of the tube sheets is one of the most important features of a well-made tubular boiler. There is good reason to believe that too much of the duty of holding the tube sheets in position has been placed upon the tubes. Great care, intelligence and ingenuity have been devoted to securely bracing the upper portion of the front tube sheets, but scarcely any attention has been bestowed upon the question of how efficient are the tubes as stays, or how much is the tube damaged by being converted into a stay. There is very little accurate information to be found concerning the holding strength of tubes, yet boiler-makers have assumed the strength to be sufficient for any pressure, but the prevailing leakage of tubes would seem to indicate that the bracing action leaves too much movement.

Mr. Wm. H. Hoffman, a well-known mechanical engineer, made some experiments a few years ago to test the efficiency of tubes as boiler braces, which were well worthy of greater attention than they received.

The first tests were made to show the effect of beading over the ends of the tubes. The tube, set in a 3/8-in. plate, was rolled and beaded with great care, and sustained a pressure of 32,000 pounds before it showed signs of starting. The next test was made under the same conditions, except that the tube was not beaded—simply expanded and left to project 1/2 in. through the tube plate. This tube started under a pressure of 16,380 pounds. The third test was made with a tube plate 1/8-in. thick, the tube very carefully beaded over. The expander was not so freely used as during the first test. The tube stood 34,880 pounds pressure before the beading began to curl up. In the fourth test the tube was simply expanded in a 7/8-in. plate and left to project 1/2 in. Movement was detected at 18,800 pounds. The fifth test was with the tube beaded over in a 1/2-in. plate. It resisted 36,970 pounds pressure before giving out. The sixth test was the same, except that the tube was not beaded. Failure came under 22,100 pounds. Next, a tube beaded in a 9/16-in. plate stood 37,000 pounds. The same conditions being repeated with the flue simply expanded, failure resulted under 23,830 pounds.

A little calculation would show that the resisting power of the tube as a stay was amply sufficient for the highest steam pressures yet reached, but these tests were made with the tubes set as carefully as skill and attention could do the work. The work of the ordinary boiler setter is very far short of this. Then, the tubes in the middle and top rows are hotter than the others, since they carry the most intensely hot fuel gases and expand enough to push the tube sheet outward. A stay rod strong enough to resist this tendency is certain to help in preventing leakage.

Waste in Steam Heating.

"The cold weather of last winter," remarked the Consulting Engineer, "put to a severe test many of the appliances used for heating cars and buildings, but it appears to me that steam has come out at the top. When heat transmitted by steam has been intelligently attended to, it has been found equal to the most exacting requirements. There was a great deal of difference to be noted as to the heating efficiency of steam on different roads; but this was almost entirely due to the intelligence or the ignorance of trainmen. You fellows are constantly writing about instructions for engineers and firemen, but the class that needs instruction, more than any other, is conductors and brakemen—the latter, by the way, ought to be called car porters. They never do any braking, and would not know how if they were called upon to do it.

"I met with a curious case of building-heating in Chicago last winter. I happened to call upon the general superintendent of a leading road who is an old friend, and he told me that they had had a dreadful time keeping the building above the freezing point, and that they were thinking of putting in a new boiler. Then he said, 'You are something of a steam-heating man; come and look over the plant.'

"I accompanied him down to the cellar, and found a fine boiler being pushed for all it was worth to make steam for a building that seemed entirely within its capacity as a heat generator. The fireman assured me that he had done everything in his power to keep up steam, but that the drain was too much for his boiler. The engineer assured me that the boiler had supplied its utmost capacity, but that it was not equal to the demand.

"I got particulars of the boiler's dimensions, and then figured on the number of rooms to be heated, and the figures indicated that the boiler ought to be perfectly equal to the steam requirements. On telling this to the superintendent, he directed me to make a thorough investigation and the company would stand the expense.

"I then went over the piping and radiators, and found them to be properly arranged and in good order. Then I returned to the cellar and watched the boiler. There certainly was enough coal consumed to produce all the heat required, and the fireman was skillful and laborious. After watching him for an hour or two I thought it would be a good plan to look into the smokebox, as the firebox seemed all right. When I looked into the smokebox I noticed at once that most of the tubes had a remarkably small opening. A closer inspection showed that they were nearly all thickly coated with a heavy lining of soot.

"'When did you clean these tubes?' I inquired of the fireman. 'Never cleaned them at all,' was the answer. 'Did not know that they needed cleaning.'

"A tube cleaner was at once put in operation, and there was no more difficulty in keeping the building warm.

"I have been speculating ever since on how much the company lost by keeping an engineer of the building who did not know enough to run a saw mill engine."

The Brakeman Hung On Too Long.

A local character on the East Iowa division of the C. & N. W. Ry., whose name we will call McGinty, figured as chief actor in the following tale, as narrated to a roundhouse audience by one of the "boys."

"One time coming into Beverly, where they were to take water, they found another train on the main line, so they had to pull in on the side track, cut their engine off, and go round the other way to get at the tank. The way car stood so that they could not get directly under the spout, but had to pull it around about as far as it would go, and McGinty found that he could not hold the spout in the manhole of the tank and pull the valve rope at the same time. Spying a brakeman, he called out, 'Say, yees, cum oop and pull down the roop.' The obliging brakey climbed up, and with one foot on the back of the tank and the other on the way car, pulled down the valve rope, while McGinty lay at full length on the spout to hold it in the manhole.

"From some cause the engineer of the train on the main line pulled up, and taking the brakeman unawares, left him swinging in the air, holding on to the valve rope, while McGinty lay on the top of the tank, where he had been thrown when the weight of the brakeman pulled the spout up, with the water pouring over him from the now uncovered tank pipe, and yelling every time he could get his breath, 'Lave go the roop! lave go the roop!'

"Meanwhile the poor brakeman was dangling in mid-air in imminent danger of falling into the barrel put under the spout to catch the drip, and was only re-

leased from his perilous position by the pumper who, attracted by the noise, came out from his house, and taking a long board, swung the brakeman from side to side until he could drop clear of the barrel on to the track, where he lay stunned by the fall on the hard ground. Carrying him into the pump house, an effort was made to revive him, when McGinty appeared on the scene, dripping and shivering, and ejaculated, 'Ye dom fool, phy didn't yees lave go the roop.'"

Wanted Something Left to Take Home.

Ben Kileen was reared on a sand foundation farm of Indiana, where plowing was light and the crops of the same character. From an early age Ben was moved by an ambition to rise above the drudgery and plain rations of farm life. He was gifted with glibness of speech, and his friends told him that he would make a famous lawyer, and as a preliminary to that exalted calling he turned his attention to politics. This did not advance his prospects rapidly, but he made the acquaintance of the assemblyman for his district, who advised him to go into railroad life, where the chances for success were splendid. As a return for certain small electioneering favors, he gave Ben a letter of introduction and recommendation to a superintendent of one of the Pennsylvania lines.

In due time Ben found his way to Indianapolis, and gained admittance to the superintendent.

"Have you had any railroad experience?" asked the superintendent, after reading the letter. "What can you do?"

"Never had no railroad experience 'cept ridin' on the cars," answered Ben; "but I can do most anything after I hev' learned the way."

"You look pretty strong and active," remarked the superintendent, "and as I am anxious to do a favor for my friend, Mr. Brown, and I think you will make a brakeman, I'll give you a note to the yardmaster and he may give you a job in the yard."

Ben was delighted. Fortune seemed within his grasp. He went to the yardmaster and was soon initiated into the work of coupling cars.

A week after, he returned to the office of the superintendent. His faced looked as if he had been trifling with Corbett. One arm was in a sling, and he dragged one leg as if all the joints had been spliced tight. A gob of his right ear was missing. On the whole, he looked as if he had passed through a threshing machine.

On being admitted, he looked mournfully at the superintendent and asked for a pass to Kouts.

"You're not going to quit railroad life," said the superintendent. "You look as if you had been having a lively time. You are sure to make a good railroad man yet."

"Waal," was the reply, "I sorter ha' lost ambition. If it's all the same to you, I'd rudder go home, as long as there's any of me left to take along."

He Talked Too Much.

"One of the worst bores of the day," remarked the Super, "is old Wirgal, who has got the compound locomotive craze. He goes round with a roll of blueprints under his arm, and whenever you meet him in the elevator or on the street, he pulls out the roll and proceeds to tell how much he could save to your company if you will only adopt his locomotive."

"You are very fortunate if Wirgal catches you on the street," remarked the Harassed Editor. "Wirgal came into my office yesterday when I was working on the finish of the paper, and remarked that he had come in for a little chat and would not hold me a minute. Well, he unrolled his blueprints, and began to tell many things about compound locomotives that were not so. I made no criticism, hoping that he would soon exhaust himself, but his words kept running like an endless stream.

"There is within a recess of my desk a notice in bold type, 'This is my busy day; cut it short.' I slipped the cover off this broad hint and Wirgal looked at it and laughed.

"'I suppose that's a quiet hint,' he remarked, and I acknowledged that I was extremely busy. 'I'll not hold you but a minute more,' he protested, and resumed the talk stream.

"The book-keeper, who is very discriminating, came in at this point, and said I was wanted at the telephone. This is an interruption which frequently proves a success. After talking to an imaginary person for five minutes I return to my sanctum and Wirgal begins the whole talk over again.

"At this point the J. P. strolls in, and breaking in upon the storm of words, says: 'Wirgal, you compound men have taken the place of the old car-coupler fiends. You remind me of a little story.

"'There was a parrot in a certain house, and two dogs were quietly visiting near the parrot's cage. The parrot, wanting to see a little fun, began calling—sickum Fox, sickum Tom, and soon the dogs were having a hot fight. After they had chewed each other up till they were tired, they took a rest and looked round for the man or boy who had been egging them on to fight. Not seeing anything but the parrot, which was sitting grinning, they understood where the sickum came from and went for him. The feathers flew in all directions for a minute or two, but the talking bird was rescued with his tail gone, his wings shattered and a general plucking.

"'As he crawled back into the fragments of the cage he was heard to remark sadly, I talk too much, that's what's the matter with me.' Wirgal took the hint at last."

Mr. Clement E. Stretton, C. E., has contributed an article to the *Railway World*, of London, on the "History of the Bogie as Applied to Locomotives." Most of our readers understand that "bogie" is the English name for our engine and car truck. It may not be so generally understood that English writers claim that the truck originated with them, although none of them were used in that country until after the Pullman cars were introduced on the Midland of England, in 1876. Mr. Stretton very fairly discusses the claims for this invention, and gives America the credit. He admits the claim of Americans that John B. Jervis was the first to make practical use of the truck on locomotives. It was first applied to an engine called the "Experiment," built for the Mohawk & Hudson, in 1832.

Solid emery wheels are designed for grinding and not for polishing. Emery wheels for polishing are usually made of wood or metal, and provided with a rim of leather or other material coated with emery powder. A good composition wheel for polishing is sometimes made by mixing coarse emery powder with about half its weight of pulverized Stourbridge clay, and a little water or other liquid, to make a thick paste. This is pressed into a metallic mold by means of a screw press, and after being thoroughly dried, is baked and burned in a muffle at a temperature above a red and below a white heat. This wheel will cut well and wear well; but there is danger of its bursting when subjected to the high speed required for polishing. Therefore it should be provided with a strong iron guard to prevent accident to operator.

"Speaking about train speeds," remarked Mr. Dyer Williams, of the Williams Car Coupler Co., an old-time master mechanic, "a speed of 80 miles an hour was common in England twenty years ago. On my way from Paris to London in 1874, we were delayed in crossing the Channel, and left Dover about an hour late. Myself and Mr. C. C. Bradley, of Syracuse, N.Y., took a compartment of the car next to the engine. The latter, by the way, had single drivers 81 in. diameter. We had not started long when I noticed that the speed was becoming terrific. Mr. Bradley had a fine watch, which he held noting the time, while I called out the mile posts. We timed for 15 or 20 miles, and the slowest mile was 50 seconds and the fastest $44\frac{2}{5}$ seconds. That was 80 miles an hour."

It seems odd to an American to read in such papers as *Engineering*, of London, an argument in favor of cabs on locomotives. One writer on the subject has the temerity to suggest that the screw-reverse is not the best thing out, and adds that the American "regulator" (balanced throttle valve) is a good thing. *Railway Engineering*, of London, should jump on this blow at English design at once. It is bad to have Yankees criticise, but to be stabbed by a member of one's own family is awful.

PRACTICAL LETTERS FROM PRACTICAL MEN

A Scot Skeevers o' Auld Lang Syne.

Editors :

With your kind permission i wud like tae tell Mr. Skivers aboot ane or twa bits o' object lessons i ynce seen whin i wus working in a big machine shop in the auld countrae some therty year sin. The foresman wus an auld furrant cheil, somethin' like Skivers. Efter he had triet aw the plans he cood think on tae smertan up his men, *still* he wasna setisfit ; he nixt got a bress band in the shop and made them play tunes sic like as Cokabendie, Maggie Lauder, and Pop Goes the Weasel. It wis the cure, and nae mistak, wis the bress band. Everybody efter that wis as lively as crikets, and whustled and sung frae mornin' tae nicht, and aw the bilermakers, smiths and machinists keepit time to the misik wi thur hemmers, so that in wee while the ootpit o' wark wis nearly doobled.

The foresman tried the band on the Auld Tilt Hemmer that wis driven wi' the water wheel in the smidy ; it wadna dae there tho'. Ye see, he wis gaun on the theory that soond trevals like the waves o' the sea, throo the air ; but whit de ye think, he did? As fack as ocht he got a Hielan' man that played the Bag Pipes. Ye must understan', Mr. Editor, if ye dinna ken already, that pipe misik is coorse a wee, and maks guid big waves whin it's trevellin' throo space. Weel, he planted the Hielan' man a dizen o' yairds up the water, aback o' the wheel, and gard him play jigs, strathspeys an' reels, sae that the waves frae the Bag Pipes affekit the water somethin' like what a cyclone does on Lake Shooperier. The consekwens wis, the wheel birlt roon that quik that the Tilt Hemmer went as fast as a needle maker's ; the Blacksmith got humpy backit heatin' and rinning back and furrit wi' Red Hot bars o' Iron to that Auld Tilt. If ye wull aloo me, i'll finish wi' anither one.

The firm had a patent on lang wooden spiral columns, i don't mind the exak lenth ; it's sae fanr back, therty year, that a body forgets sma' maitters. Hooever, the columns were turned up in the lang screw-cutting lathe—there wis 4 threeds or spirals on each, sae ye can see that it wis a coorse pitch—an' the carriage o' the lathe trevelled quick ; it didna travell, it went like Sunol or Maud S. We all had a trial at the screw-cutting ; one fellow even went for it barefittit ; but none o' us cood keep up with the carriage.

Here, again, the foresman come oot his shell ; he got a sprinter wi' a 10 and a 15/16-second record, and broke him in at common screw-cutting for a week or twa, and then put him on the lang lathe. Us boys used to look on the sprinter as a scab efter that, which wasna just exacly fair, seeing he accomplished whit we had aw failed to do. Hoping Mr. Skivers will be long spared to give his reminiscences vent through the columns of your widely circulated journal for the benefit of the machinists of this and future generations.

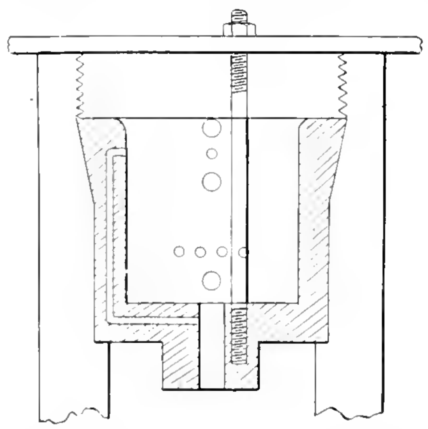
John Gilchrist.

Livingston, Mont.

Device for Removing Reversing Cylinder of Air Pump.

Editors :

I hand you herewith a sketch illustrating a "kink" for removing the reversing cylinder of a Westinghouse air pump in order to get at the main valve without removing the head, thus avoiding so far as



possible leaky heads, and at the same time enabling one to get at the valve as soon as possible, where a diagnosis of the case indicates this particular part to be at fault.

As near as possible to the center at the bottom of the cylinder, and on the *opposite* side from the small port, drill and tap a 3/8-inch hole 1 inch deep ; when it is desired to remove the cylinder, use a steel stud made long enough to come to the top of the head and take a plate laid across the head. This cylinder can be drawn, by screwing a nut on the stud, in about the same length of time it would occupy to take out a cap screw. In case a cylinder should be unusually tight, after taking sufficient strain on the stud, a smart rap on the side of the head will start the most obstinate one. Removing these by blowing them out is not practicable at all times, while this way of removing them is. The cylinders need only be drilled as the pumps come to the shops for repairs, or in case one is renewed in doing running repairs ; but when once drilled will be found to be a great convenience.

L. M. Carpenter.

Chippewa Falls, Wis.

Is It Not Inconsistent to Put a Cinder Catcher on a Locomotive That Does Not Throw Cinders?

Editors :

The particulars of construction and performance of the Richmond Locomotive Works compound No. 2427, given in your May issue, indicate the engine to be so well and correctly designed, as a whole, that the inquiry which I desire to make regarding it, so far as it may be in the nature of a criticism, should not be regarded by the builders as an invidious one. That inquiry is—What is the object, function, duty or reason for existence of its extended smokebox? I am perfectly aware that a similar inconsistency is presented in all, or nearly all, American compound locomotives of other constructions—excepting, so far as I know, the later Johnstone ten-wheel engines of the Mexican Central—and I endeavored some two years ago, by a published communication of the same character as this, to ascertain the reason from the builders of another type of compound, but only obtained in reply an explanation which ingeniously dodged the question and did not *explain.*

It is the ordinary theory—although in some cases, with which you are, no doubt, as familiar as I am, an entirely erroneous one—that the exhaust of a compound locomotive is so easy that the fire is not lifted, and no appreciable amount of unconsumed coal is drawn into the smokebox or thrown out of the stack. With a properly designed engine, particularly as to sufficiency of grate area, this theory should, however, be a correct one, and I assume that it *is* so in the case of the Richmond engine. It therefore seems inconsistent, unreasonable and useless to employ an extended smokebox, the purpose of which (so far as I can understand anyone who favors it) is, first, to allow sufficient netting area to arrest sparks, and second, to serve as a cinder receptacle. Briefly, then, why is this alleged spark arrester and cinder receptacle, with its dead weight, cost and ugliness, put on an engine which is not operated under such conditions as to throw fire or fill up her front end?

The extended smokebox, whether on a compound or a simple engine, is also inconsistent, as good practice, with the results of the careful tests made by the Master Mechanics' Association Committee on Exhaust Nozzles and Steam Passages, whose report, at the 1894 convention, was received without dissent, and characterized as an "interesting" and "creditable" one. Among the conclusions of the committee is, "That an increase in the length of the smokebox, over and above that necessary to get in a cinder pocket in front of the cylinder saddle, is unnecessary and undesirable, as the long smokebox greatly decreases the vacuum" (Report of Proceedings, page 112), and in the discussion upon the report, a member of the committee, whose experience and ability, both on it and in regular service, will hardly be questioned, said: "I believe that the trouble is not with the stack, but with the long front end, and I think it is pretty near concluded now that the long front end is not in it with the short front end."

The extension on the last Richmond engine is apparently considerably shorter than that on their preceding engine, which, I believe, is running on the Big Four road; and this fact indicates that the subject has had consideration in the right direction, but not, as it seems to me, to a sufficient degree, as there is evidently nothing in the construction of the receiver, or other inside parts, which would require any extension beyond the front of the saddle. An expression of the builders' views upon this point would, I am sure, be of general interest, and if they would also favor your readers with an illustration of the intercepting valve, which, from your description and the fact that there was an entire absence of pounding and jarring, I understand to be a positively operated one, probably even those who are still victims of the extension craze will not find fault with me for endeavoring to obtain further light upon the question.

J. Snowden Bell.

Pittsburgh, Pa.

"Where Are We At?"—A Word of Advice for Future Inventors.

Editors:

To apply to the air-brake situation the above quoted forcible language is, we hope, excusable in the light of distinguished usage. "Where are we at?"—that is the question. For years we have witnessed a steady rise in the flood of improvements in the air-brake world. Surely there must be a high-water mark somewhere. Indications point to a turn in the tide at no very distant day. Amongst all the many new devices that have appeared lately, but very few, if any, have revealed anything in the nature of an improvement over the present forms. The aim of many seems to be to get something "just as good," and little effort is made toward something "better." This must be an indication that the height of perfection in this class has been attained. What great benefit has a man conferred on the world at large who has designed something which is only "just as good?" If no one made anything which was better, the world would soon come to a standstill. In fact, the tide would then begin to recede, for in reality there is no such thing as standing still. We either go forward or backward. If we are not going forward we must, perforce, be going backward.

Few inventors seem to be aware of the state of development that has been reached in the air-brake art, or of the condition that confronts the inventor of the future. Great changes in the whole transportation system are now imminent. We do not see how this conclusion can be avoided in the light of the immediate past. No engineer who has ridden much at a speed exceeding a mile a minute ever desires to get a permanent run where the speed is or may be at a rate of 100 miles an hour. Such speeds, if they are attained regularly—and we believe they are likely to come within a very few years—must be secured by other means than those at present in use.

And now for the advice which was promised at the beginning of this article. They say, "Advice is cheap, but it takes money to buy whisky." Of the truth of the latter part of the saying there can be no question, but as to the first we have some doubts. Poor advice, if followed, may prove very dear. Good advice, if followed, may turn out very valuable.

The important thing in entering a new field is, first, to find out what attempts have been made by others in the same line; and second, and equally important, not to follow blindly the path marked out by others. Get out of the rut. Look back over the record of the past and see how the most successful devices in every line were only found when some enterprising man cut loose from all the established notions and followed his own intuitions. Witness the case of the development of the railroad car. The early ones were all, more or less, reproductions of the coach, set up on flange wheels. Finally some designer found that there was no valid reason why that form should be so closely copied, and made a car which, while having roomy and comfortable seats, also afforded ready means of communication between the different parts of the train.

The writer has noticed recently that the work that has been done in the line of electric brakes shows this same tendency. Many of them are arranged with practically the same forms of lever, shoe, rod, beam, etc., as is used in air-brake practice, and some even counterfeit the appearance of the air cylinder. Can any rational man say why? Again, see how in the development of the electric motor the appearance of the locomotive has been followed. What reason is there for making an electric motor look like a locomotive? Who cares if a thing does look odd at first, if it works better in a new form. The form which is the most useful is always the most beautiful to the mechanical mind. Herein is the true secret of mechanical beauty. Let every design be submitted to a test as to its simplicity, adaptability, directness, strength, facility of operation and repair, and we should see fewer of the mechanical abortions which afflict our sight at the present day.

Let us suggest that the present form of air brake be given a rest and something different tried. We do not wish to discourage inventors. On the contrary, we desire to offer all the inducement possible to men of mechanical genius to continue their creative labors. But we do wish to try to lead more of the active minds to newer fields. See if some means cannot be found which will increase the speed of travel and at the same time *reduce* the danger, instead of *increasing* it. Something entirely new is what we need. Let us see if it cannot be found.

Chicago, Ill. Paul Synnestvedt.

More Trouble for Doc.

Editors:

I met Doc in Chicago the other day. I was very glad to see him again and have a talk over old times, but he looked blue and downcast; it seemed as if he had trouble on his mind. What got him away from home puzzled me, so I said: "What ails you, old boy? What brings you up from Indianapolis? Have you had bad luck?" He said he was "laying off for a few days to make the General Superintendent good-natured. The fellow who does the laying off ain't very good-natured, as a general thing; there ain't enough good nature for two in this case. You see, I got on to a railroad crossing one night last week; the brake didn't hold worth a darn; somebody reported it, and day before yesterday the old man called me in about it, and then both of us went up to see the General Superintendent, who says, 'Why did you fail to make the stop?' Says I, 'The brake failed to hold me.' Says he, 'Do you know what was the reason?' 'Well,' says I, 'all I could find wrong was, the man who had the engine out the trip before let the main reservoir get water in it; it was about one-third full when I come to drain it, so I didn't have air enough to stop.' The superintendent braced up mighty quick and wanted to know if it was the air in the main reservoir that stopped the train with the automatic brake. I told him that it was the air in the main reservoir that did the work with any kind of a brake. Then he lit on to me like a turkey on a June bug, and asked me more questions about air than I ever heard of before. Says he, 'How much air did you have in the train line before you began to set the brake?' 'Seventy pounds,' says I. 'Well,' says he, 'how did you set it?' 'Very easy,' says I, 'so as not to shake up

anything in the dining car, about two or three pounds at a time; still I found we wasn't going to stop, and I give it all to her.' 'Did you set it hard enough the first application to cover the leakage grooves?' says he. That question stumped me, and he fired half-a-dozen more, till I begin to think an air-brake instructor had got after me. I tried to explain just how I thought the brake worked in this case, but he was too many for me. The old man put in his oar once in a while, and tied me up with some question I couldn't answer, for I had never heard of it before. Well, the seance wound up by his telling the old man to have me examined and instructed in the air brake before I run passenger again. I just boiled over at that, and says: 'Must I go and get examined on the air brake, just like one of those promoted men, after all the years I have been running a passenger train?' Says he, 'That is what it looks like, Mr. Troy. Your explanations here to-day show that you do not know all you ought to, if you are to handle one of our important trains.' I tell you, Clint, that was the hardest shot I ever got in all my railroading, and me running a train when he was a clerk in the despatcher's office; he is a mighty fine man, though. I see by his way of talking it was no use; so I went out and hunted up Ike, told him how I was fixed, and asked him what all this funny business meant. Says Ike, 'The General Superintendent takes in an air-brake car pretty regularly—something you have never done—and he is pretty well posted. Our old man knows all about the air brake, too. Some of our officials have had five or six lessons in the instruction room, and they are catching on in good shape; in the meantime, you have never been near one. Now, if you would come around and see me before you get into trouble with the brake I could help you, but you hate to show up along with the young men; besides, you have got an idea that because you have been at it a long time you know it all, and look down on a man that is trying to learn about it. Now, if you can't pass examination on air brake you dont' know much, for it is easy enough if you only try it. I will help you all I can, but you will have to commence at the bottom and learn it right; in four or five days you will begin to get a good insight into the way it works.' The way Ike talked pretty near took my breath away; he had more gall than the officials, but he was so quiet and good-natured. Says I, 'See here, Ike, if you think I am going to air-brake school along with them young firemen, you will get left. I will take my case up before the committee and see if I can't get justice and my run back.' Says he, 'See here, John Troy, don't get in a hurry and go off at half-cock; you want to be just as well posted as anyone in your business. How will you learn it? By getting hot, and going to the committee and have them laugh at you? Every man on the committee is way up in the air-brake knowledge, they are all right; they won't take up a case of ignorance, they will save their strength for something bigger than your case will be.' Wouldn't that skin you, to be talked to that way when you were in trouble? Says I, 'Bad luck to the man who ever put it into the superintendent's head to learn about the brake. It used to be that when anything went wrong with the brake so we couldn't stop, we just reported that the brake failed to work and it didn't bother us any more; but if we have got to explain all about it every time we miss a stop, it is going to take all the comfort out of running an engine nowadays. The brake don't hold just the same every stop, and it never will; I don't see why they should make us fellows responsible for knowing just exactly what is the matter. I know mighty well the brake give out this time.' 'How do you know?' says Ike. 'Well,' says I, 'what is all this about leakage grooves, and light applications the first time, and all that?' 'That's the way to talk,' says Ike, 'that's business; now you are beginning to want to learn.' So he went at me and explained about the brake till I have got leakage grooves, graduating valves, equalizing pistons, train-line exhausts and a whole lot more curious brake wheels all going at once in my head, so I come up to Chicago to get rid of him. Ike is all right, and he is trying to show everybody how it works, but he will talk air brake instead of going to dinner. Now, Clinton, what had I better do about this matter?"

I told Doc. to "go home, get an instruction book, look all through it; when you find anything you can understand, study it up till you are sure you have got the right idea of it; when you run across anything you don't understand, go to that son-in-law of yours—young Brown—he will show you all about it and keep quiet about it. And then, when you go to the air-brake school, sit on a back seat the first day and take in the explanations, talk it over with Brown again that night, and in three or four days you will be surprised at how plain it seems to be getting to you, and the young fellows in the class will think you are well posted. When Ike has had you a few days, tell him to ask you a few questions and correct you if you are wrong, and in ten days you will pass a good examination, besides getting interested so you will want to learn more all the time. That is the way the air-brake business works on a man; after he gets so he can explain it pretty well, he puts in lots of time talking about and learning it. Send to LOCOMOTIVE ENGINEERING for an Air-Brake Catechism; it will only cost you 25 cents and will give you lots of pointers on the every-day operations of the brake.

"Of one thing you can be sure, you won't be the only old engineer that will be called in to pass examination on the air brake. It is coming on all the railroads—in some cases they kick and hang back—but they must come to it sooner or later, generally sooner.

"You ought to be glad that the officials have taken to learning about the air brake; they will give you a better show when you have an accident, if you are not to blame—that is, if they get a thorough knowledge of it; a little knowledge is a dangerous thing. Then, there is another advantage in the officials learning about the brake, they will take an interest in having it well taken care of so it is safe to use; when the officials know very little about the brake they generally care less, and it has a hard time getting proper care. Brace up to business, Doc; keep up to the times if you want to railroad on the head end; you can't do it if you spend your time kicking about examinations, etc. I have no doubt that if half the time and brain power expended the last six months in kicking and growling about the Traveling Engineers' Standard Form of Examination had been put in to answering these questions, these same kickers would know more to-day about the business of handling an engine and train."

Doc heaved a great sigh, and said, "We can't never take any more comfort running an engine; too many arrangements now to keep you on the jump. First it was get there on time, next it was save coal, then it was save oil, now it is go to school like a lot of young firemen and learn about the air brake. The length of time a man has run an engine don't seem to count any more; it's all examination and certificates, about your eyes and ears and watches, till a fellow don't know where to go to have any peace.

"I'll do as you say, but it ain't because I want to; it's because I have to, or else drop back on a switch engine."

C. B. CONGER.

Grand Rapids, Mich.

Where Gum May Help Make a Tight Joint.

Editors:

In the last issue of your paper I notice something in an article by Mr. Geo. Holmes about which I should like to say a few words. He comments on the fact that an equalizing piston that had been run some time proved tighter on test than one which had just been cleaned, and inclines to the theory that it may have been due to a buckling or slight depression of the outer circumference of the piston head because of the fact that it is supported from the center. To just what extent this would affect the results of the tests noted is a matter of doubt, but I think that the main cause of the variations found were due simply to the fact stated, that the gum made the pistons tight. It is a fact not generally known that the use of vaseline or some similar substance is a great help in making any packing ring tight, and I have often wondered that the railroads did not find that out and make use of it. Everybody

knows that it is decidedly impossible to make a metal packing ring absolutely tight. It is in fact very difficult to get one even approximately so, especially where the apparatus used for doing it is as crude as is in use on many railroads. Let him who is doubtful try, on some obstinate case, a dose of vaseline or petroleum jelly.

PAUL SYNNESTVEDT.

Chicago, Ill.

To Prevent Sliding of Wheels.

Editors:

At the St. Louis meeting of the Air-Brake Men the discussion that followed the report of the Committee on Slid Flat Wheels brought out the advice to engineers to try and prevent sliding wheels when making service stops—by making a practice of "kicking off," or the momentary release and a second application of the brakes.

With short trains and under favorable conditions this can be done, and it will give good results; but with trains of six or more cars the same practice will be dangerous, and often be the cause of breaking the train.

Another way suggested was to commence early, and make but one application and the early release, etc.

I find that the man that has the largest flat-wheel account is the man that makes but one application, and does *not* make it in the *right* manner.

Some engineers, when making service stops, commence early and make two or three light reductions (say 3 to 5 lbs.) each time, and then to prevent running past must make the last reduction from 15 to 20 lbs.

In this application you have the highest pressure in the brake cylinders at a low speed, when wheels are easy to slide, and having so much air to get out of the cylinder, with the release of the brakes, it is very hard to prevent that disagreeable jerk or recoil from the trucks.

To keep up with schedule figures as now arranged, requires running into stations fast and getting away quick. To do this, run close and make the first reduction as heavy as possible (say 8 to 12 lbs.) as the speed and grade will permit. If any further reductions are necessary, it will require but a very few pounds to stop the train.

With this application, the highest pressure possible is in the brake cylinders, while the train is at high speed, when it is very hard to slide wheels; and as the speed reduces, the breaking power is also reduced.

And having less air in the brake cylinders at the time of the release of the brakes, it will not be so hard to prevent the jerk from the recoil of the trucks.

I would also say, if the condition of the rails is known to be bad from any cause, the flat wheels will be less if engineers will let sand to the rail before and during the application of the brake, while the train is at high speed.

Don't let sand down after the brake has been on and speed partly reduced.

J. R. ALEXANDER,
Air-Brake Instructor Pa. R.R.,

Altoona, Pa.

Flue-Sheet Stay Rods—Not Invention, But Use Claimed.

Editors:

In your May issue, Mr. M. O. Connor accuses me of claiming the introduction of the stay rods through flues to prevent leaks. My letter in your April issue reads, "The same thing was done by me in 1893," which is no claim for the introduction of them, any more than, the account in the February issue was a claim for Mr. Buchanan having introduced them. In each case it simply stated what had been done. But I do claim, if these stays are a temporary relief to an engine that is fit for the back shop, when otherwise it would have to go in, surely they are a preventive of the cause of many of the leaks; consequently would be a permanent relief.

Osceola, Ia. E. DAWSON, M. M.

Independent Driver Brake from Engineer's Valve.

Editors:

The engineer's valve, as made by the Haberkorn Air Brake Company, will set the driver brake independent of train brakes, or train brakes independent of driver brakes; set train brakes and driver brakes at the same time, release the same, or independently, as the engineer may wish. One of the first valves of this make has been in use about five years on the C. H. & D. R.R. passenger engine No. 111, running between Cincinnati and Lima.

R. E. STATE,
Air Brake Dept., Big Four.

Bellefontaine, O.

Our Car Dictionary.

With this paper will be found a dictionary chart of an American Passenger Coach and a Wagner Sleeping Car. No one but an artist can appreciate the time and care required to draw such a picture, to make parts transparent, and show up every detail that goes to make up a passenger coach. Every system is complete; every pipe and cock and fitting of the air, steam or water connections can be found, numbered on the plate and named in the list. We only hope that this chart will do as much good and be as popular as was the transparent chart of the engine—given last year. More than 50,000 of these have been issued, and it is framed and preserved in more railroad offices and shops and in the homes of more railroad men than any other one picture ever printed. Duplicates of the car chart, printed on fine paper for framing, can be had at 50 cents each, mailed in a tube, free from wrinkles and creases.

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MADE WITH NEATNESS AND DISPATCH BY
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We are headquarters for all sorts of models of R. R. appliances, experimental machinery, and solicit correspondence from inventors who want their patents put into manufacturing form for display at conventions, etc.

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FOR FASTENING ALL KINDS OF STRUCTURE TO BRICK AND STONE WORK.

Patentee and Mfr., ISAAC CHURCH,
SEND FOR CATALOGUE. 1521 *Walnut St.*, TOLEDO, O.

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A New Movement.
A Perpetual Compound Lever.
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One Man Can Lift to the Full Capacity of the Block.
Self Sustaining at Any Point.
The Block Always Hangs Plumb

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Link-Belt Engineering Co.
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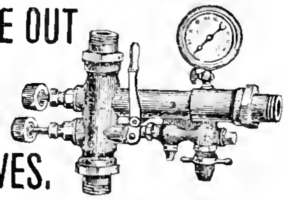
Coal and Ashes Handling Machinery,
Of Modern Design,
To meet any conditions.
Western House:
Link-Belt Machinery Co., CHICAGO.

PUMPS ARE OUT OF DATE ON LOCOMOTIVES.



Because injectors are better in every way. Pumps are also out of date for boiler washing purposes. Here is a jet instrument that occupies no room, needs no foundation, and takes cold water, delivering it hot. The best washer for the boiler. With the testing attachment you can put 300 pounds of hot water pressure on a boiler using 100 pounds of steam. The whole thing in compact shape, showing just what pressure you are using. You can buy ten for the price of one pump of the same capacity.
ALSO, LITTLE GIANT INJECTORS.
Rue Mfg. Co., 119 N. 9th, Philadelphia, Pa.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(84) Apprentice, Erie, Pa., asks:

Why are square threads used on the lead screws of lathes, on screw jacks, etc.? Would threads made of the standard V form not work as well? *A.*—The square thread is employed because there is less friction with it than any other form, and consequently it will wear longer.

(85) D. P., Plattsmouth, Neb., writes:

We have had a dispute about mineral wool. One side says that it is a natural product like asbestos, the other side says it is a silicate of soda made by some manufacturing process. Which side is right? *A.*—Neither side. Mineral wool is made from the slag of blast furnaces, and it contains all the ingredients found in the slag. Its value as a non-conductor of heat lies in the fact that it encases in its interstices about 90 per cent. of air.

(86) A. B. R., Springfield, Ill., writes:

Must a man be able to do all sorts of work in a machine shop to be considered a first-class machinist? I have been nearly all my life on machine work, and the foreman called me a botch because I could not finish a set of links to his satisfaction. Do you consider that fair? *A.*—No. A man may be a first-class lathe or planer hand and be of little use on the vise. It is the business of a foreman to put machinists at the work they are most skillful on.

(87) Car Man, Detroit, writes:

Can you give me the best method for brazing saw blades? *A.*—We do not know any better method than the following: File the ends so that they will scarf; paint the ends well with borax ground up with water; bind the ends firmly in position with an iron wire; coat some small pieces of silver solder with borax, and place them on the joint; put behind the joint a piece of pumice stone, and with a blow-pipe flame heat the joint until the solder melts.

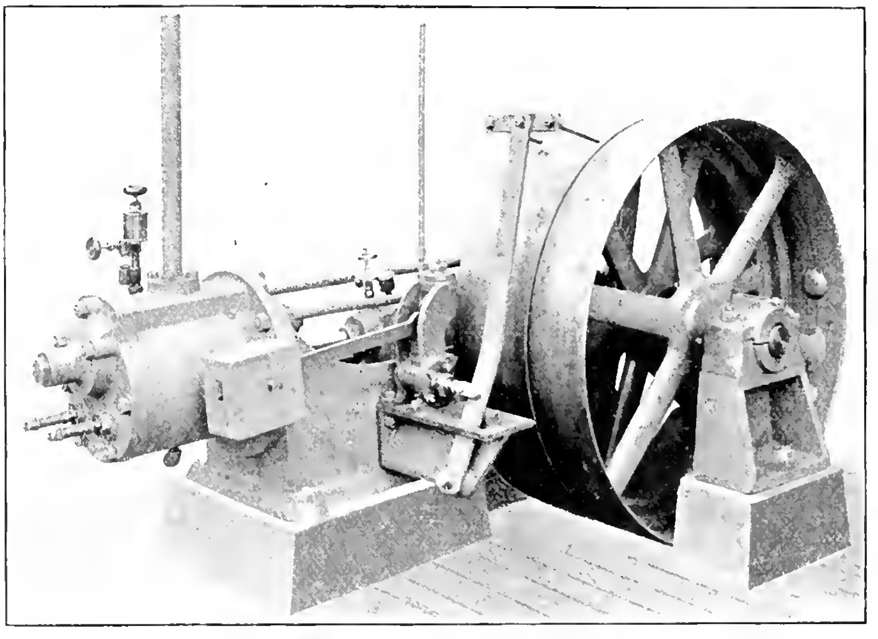
(88) P. McI., Fulton, Mo., writes:

1. Will an air gage, when connected on pipe between engineer's brake valve and small reservoir, indicate pressure in brake pipe when brake handle has been on "service stop" and then returned to "on lap" position? My friend says it will. I say it will not. *A.*—You are both wrong. The pipe to, and brake-valve reservoir, are shut off when valve is in "service stop" or "on lap"—the brake reservoir and pipe never have any connection with the brake pipe proper. 2. Will a steam gage, if left loose in a boiler, indicate any pressure in the boiler? *A.*—No; either a diaphragm or a Bourdon tube gage depends on its movement for pressure inside and the atmosphere outside; in this case the pressure would be equal on all sides.

A New Belt-Shifting Compressor.

We illustrate herewith a new belt-driven air compressor, intended more especially for railroad shop use and other places, where it is desired to drive compressors from existing line shafts, and where the nature of the work is such as to lead to an intermittent demand for the air. The machine will be seen to be of very substantial construction, and to be fitted with large and powerful driving gear. The action of the belt-shifting regulator is to throw the belt upon the loose pulley when the pressure reaches the point determined upon for the limit, and to throw it back again upon the tight pulley when a renewed demand for the air causes the pressure to drop. The machine is fitted with a water jacket, and, as will be seen, has the valves in the cylinder covers, where they should be in order to provide for easy accessibility.

The machine is made by the Rand Drill Co., 23 Park place, who have been in the compressed-air business for the past twenty years, and who make a complete and varied line of compressors for all possible services, ranging up to compound compressors with compound condensing Corliss engines, and for pressures up to 3,000 lbs. to the square inch. The company publish a number of interesting catalogues devoted to compressors of different types and for different purposes, copies of which will be forwarded upon application. * * *



RAND BELTED AIR COMPRESSOR.

A WELL-EARNED SUCCESS.

Sketch of an Up-to-Date Railroad Supply Co.

"Combination" is a significant word when applied to a business enterprise, and it frequently explains the secret of a phenomenal success—such a success, for instance, as that of the Brady Metal Co., who, about six years ago, launched their "combination," which was composed of experienced and thoroughly practical men, with a knowledge of the requirements imposed by the heavy limited train service of to-day. Mr. Daniel M. Brady, who is the president and general sales agent of the Brady Metal Co., has nearly twenty-five years' experience to his credit in railroad and manufacturing service, and during nearly half of this time he was intimately associated with the late Leander Garey (N. Y. C. & H. R. System), one of the ablest and most distinguished master car builders of his day. Mr. Adolph Onslow, the superintendent and metallurgist of the Brady Co., has had an experience of over thirty-five years, and has personally superintended the making of fully 10,000,000 car brasses. Mr. Onslow erected the first plant for the special manufacture of these improved bearings, and introduced many new methods employed by the Brady Metal Co. in the making of its self-fitting lead-lined car journal bearings.

The Brady Metal Co.'s plant is located at 202-208 Tenth street, Jersey City, N. J., and is one of the best equipped works of its kind. An idea of its capacity may be gathered from the fact that its foundry can turn out 1,000 bearings, and 10,000 pounds of engine metal, each day. The pattern shop contains over 6,000 patterns, and the furnaces, tools and appliances are the latest approved kind. Among the manufactured products of this company are Magnus Metal for locomotive engine castings, driving boxes, rod bearings, or any bearing for high-speed shafting. *Magnus Metal Bearings are in service on nine of the fastest passenger trains run in America.* Hot boxes are unknown on engines or cars when "Magnus" is used. A rough estimate by an expert on the subject of railroad metal bearings gives 3,000 to 3,500 miles per ounce of wear as good service. There are cases where Magnus Metal Bearings have a record of more than 150,000 miles to their credit, and other instances where car brasses have shown nearly 5,000 miles to the ounce of wear.

It is in the engine service that a brass receives the more even wear, as the load never varies, and a mileage in locomotive service is subject to a less discount for dust, variations in load and lack of care than in car service. A recent test on a leading trunk line, under a 70-ton engine, showed that Magnus Brass ran 3,194 miles per ounce of wear.

Magnus Tin, for use as a substitute for block tin by railroads having their own brass foundry; Magnus Anti-Friction Lining Metal, Standard Crow-foot Battery Zincs, Solder (half-and-half and other grades), Phosphor Bronze (in ingots, bearings or castings) and Babbitt Metal (nine different grades) complete the line of railroad metals furnished by the Brady Metal Co., who are always prepared to make monthly or yearly contracts to supply Magnus Metal or Brass Castings of all grades and patterns for engines or cars, at prices in touch with the current metal market.

The present office address of the Company is 115 Broadway, New York. * * *

Compressed Air in Railroad Shops.

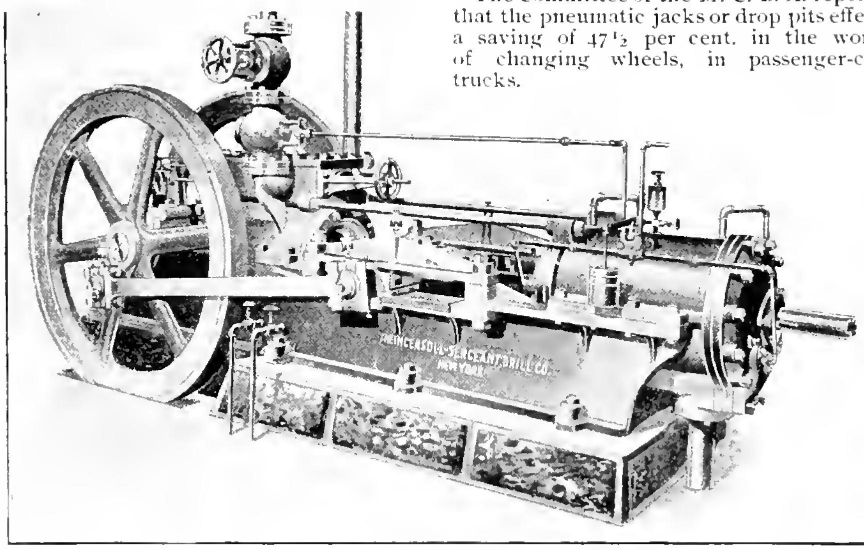
The use of compressed air has developed and become established more rapidly and more fully in the railroad shops of the country than probably anywhere else, simply because there it has been easy to procure a supply of the compressed air and to augment the means of compressing it as the demands of the service increased. This general use of compressed air in railroad shops is, as we have before remarked, a distinct outgrowth of the air-brake service. In railroad repair shops, or wherever there are a few locomotives, there is generally one of the air-compressing pumps around and not in use, or one may easily be smuggled in among the necessary supplies of the road; and it is a little matter to pipe it up in a corner—no matter if it is a ferocious steam glutton—and put it to work to operate a hoist or two somewhere. When once the air supply finds employment, one duty after another is placed upon it. Soon the pump becomes inadequate to furnish the quantity of air called for, and then another pump is added, and after that others in succession, until in some places as many as sixteen such compressing pumps have been employed together, notwithstanding that each pump uses five times as much steam as would be required by a good compressor to furnish the same quota of air. The first cost of the pumps when used in series is also greater than that of reliable air compressors. The use of compressed air in the railroad shop, and for numerous purposes around the railroad stations or termini, has now become so general that it would seem to be very desirable to see about setting up permanent air-compressing plants with reliable and economical air compressors. The Committee of the Master Car Builders' Association speaks as follows of the air-brake pump and of its use for general service:

"On account of the particular kind of service for which locomotive air pumps are designed, the necessity for simplicity will not permit of the use of cooling devices for the air cylinder, or the additional mechanism necessary to use steam expansively; and for these reasons, if air is wanted in considerable quantities, some form of compressor embodying the above-mentioned advantages and regulated automatically should be employed.

"Air is employed in air jacks for raising and lowering cars, in drop pits for removing ear wheels from the truck of cars, in portable jacks for lifting couplers into position, in jacks for pulling down defective sills from cars, for applying couplings for fittings on air-brake hose, for cleaning castings, for loading axles and wheels, for raising and lowering furnace doors; for general hoisting over machine tools, planers, lathes, boring mills, presses; for raising cast iron to cupolas, for lifting drop weights, for breaking old castings, for operating air drills and punches, for riveting car channels, as a blast for a portable blacksmith forge near repair tracks, for transferring oil from barrels to tanks, for testing air brakes, for general whitewashing, for blowing out and cleaning hot-water and steam-heating pipes in passenger equipment, for sanding freight-car roofs, sand blast for applying satin finish on silverware, car trimmings, etc."

This was, of course, an impromptu enumeration, and did not mention all the uses of air in railroad service, a notable omission being that of the use of compressed air for cleaning car seats, rugs, carpets and all heavy textile materials in parlor and sleeping cars. The use of oil for kindling the fires in locomotive furnaces, in connection with compressed air, is saving more than three-quarters of the cost of wood.

The Committee of the M. C. B. A. reports that the pneumatic jacks or drop pits effect a saving of $47\frac{1}{2}$ per cent. in the work of changing wheels, in passenger-car trucks.



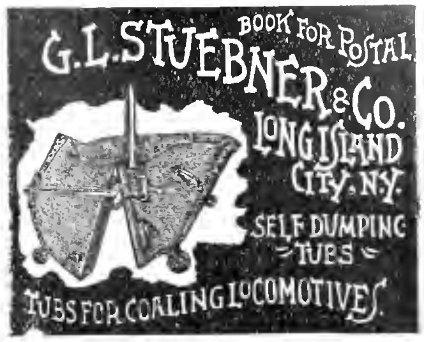
The Ingersoll-Sergeant Drill Co., of New York, make a specialty of the manufacture of various styles of compressors, both steam and belt driven, adapted for use in railroad shops. They furnish to anyone desiring them handsomely illustrated catalogues of their compressors. * * *

The Hotel Question at the Thousand Islands.

If you haven't solved it yet, and have failed to secure satisfactory accommodations for the Conventions, write H. F. Inglehart, proprietor Hotel Westminster, Westminster Park, Alexandria Bay, N. Y., and ask for pamphlet. *Harper's Magazine* of September, 1881, says: "It is unquestionably the finest location in the Thousand Islands."

Hotel Westminster is only five minutes by steam ferry from the Master Car Builders' and Master Mechanics' Convention Hall. Free ferriage furnished those stopping at the Westminster.

Don't consent to be put into private houses a long way from headquarters, when you can get a nice room and a fine table at Hotel Westminster for \$3 per day. * * *



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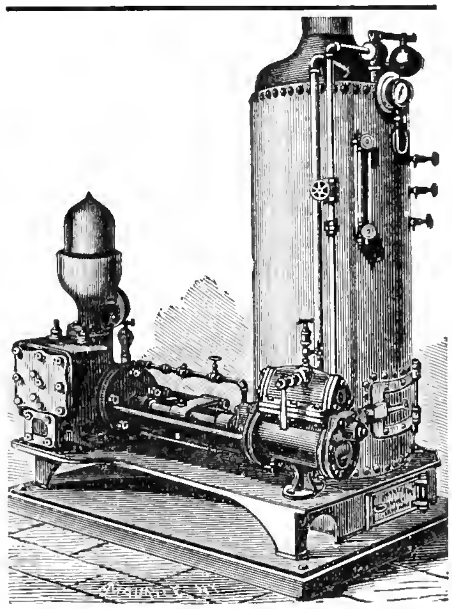

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14" Traveling Head, with Index Centers, Circular Feed and Vise, "Fitchburg."

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18" stroke, complete, "Bement."

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Swing, 54", complete, "Sellers."

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Two (2) 5-ft. Universal Radial Drills.
22 in. x 8 ft. Ames Mfg. Co. Lathe, with Turret Head, Hollow Spindle.
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40-inch Bement Vertical Drilling Machine.
24-inch Pratt & Whitney Vertical Drill'g Machine.

George Place Machine Co.,
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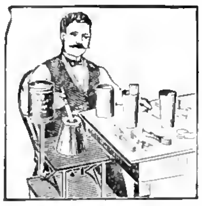

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1 60 inch Swing New Haven Pulley Lathe.
3 Bement Car Axle Lathes.
2 " 33-inch Car Wheel Borers.
1 " 42 inch " "
1 100-Ton Hydraulic Wheel Press.
1 60 " Watson & Stillman Broaching Press.
1 9-inch Bement Slotter (all feeds).
1 13 " " " "
1 14 " Lowell Traverse Shaper.
1 25 " Prentice Bros.' Drill, Power Feed and B. G.
1 30 " " " " " "
1 32 " 8-ft. D. W. Pond Eng. Lathe (very heavy).
1 Set Power Bending Rolls, 7-ft. between housings.
1 2½-inch Hurlburt Cutting off Machine.
1 4½-inch Whiton Centering Machine.

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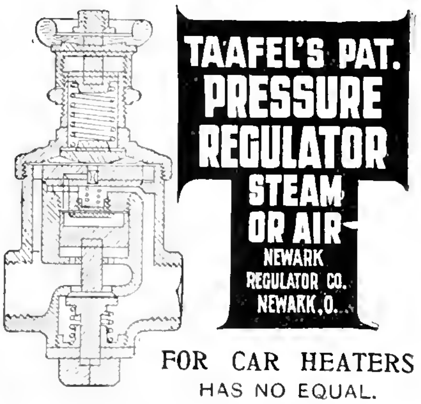

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"Diseases of the Air-Brake System,"

BY PAUL SYNNESTVEDT.

If you want a Copy send $1 to the W. F. HALL PRINTING CO., 21 Plymouth Place, Chicago.

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A "DAUGHERTY-VISIBLE"

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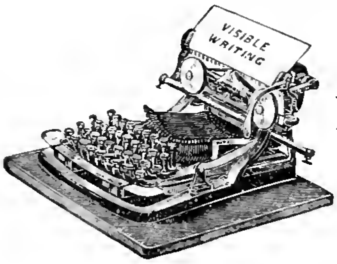

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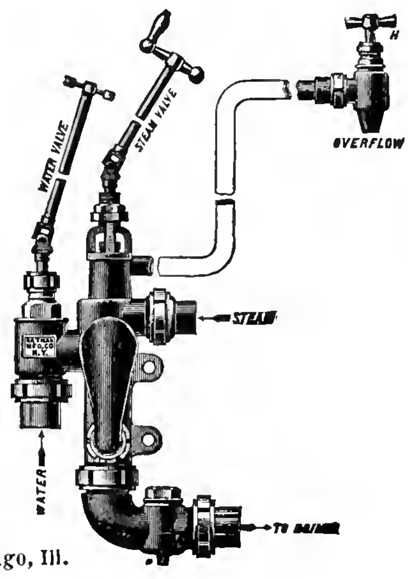

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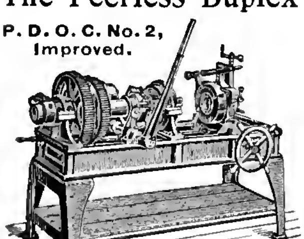

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Combination Bench and Pipe Vises.
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BIGNALL & KEELER MFG. CO.

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Classified Index of Our Advertisers.

Continued on page 382.

Continued on page 383.

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STOCKS, DIES & OTHER TOOLS FOR.....

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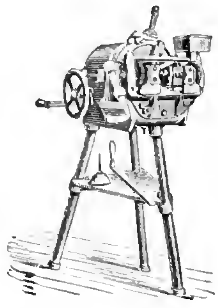
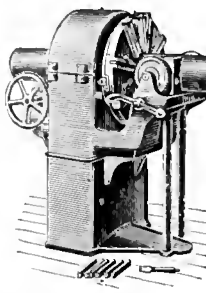


No. 1 Machine.



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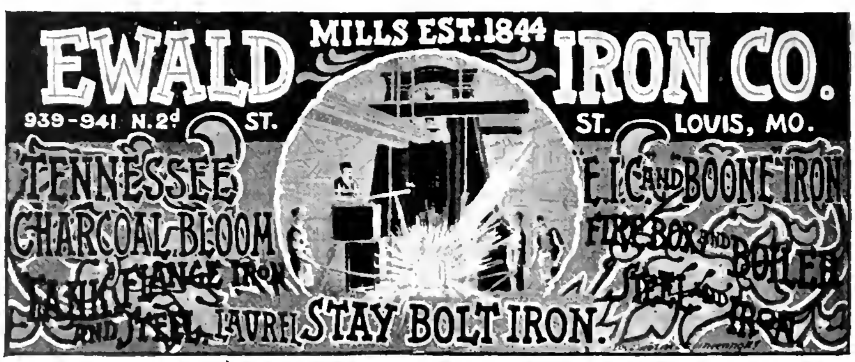

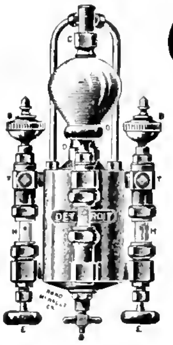

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ARE WIDELY USED AND MOST FAVORABLY KNOWN.

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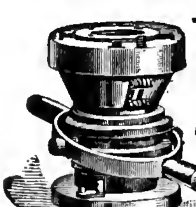

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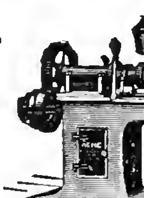

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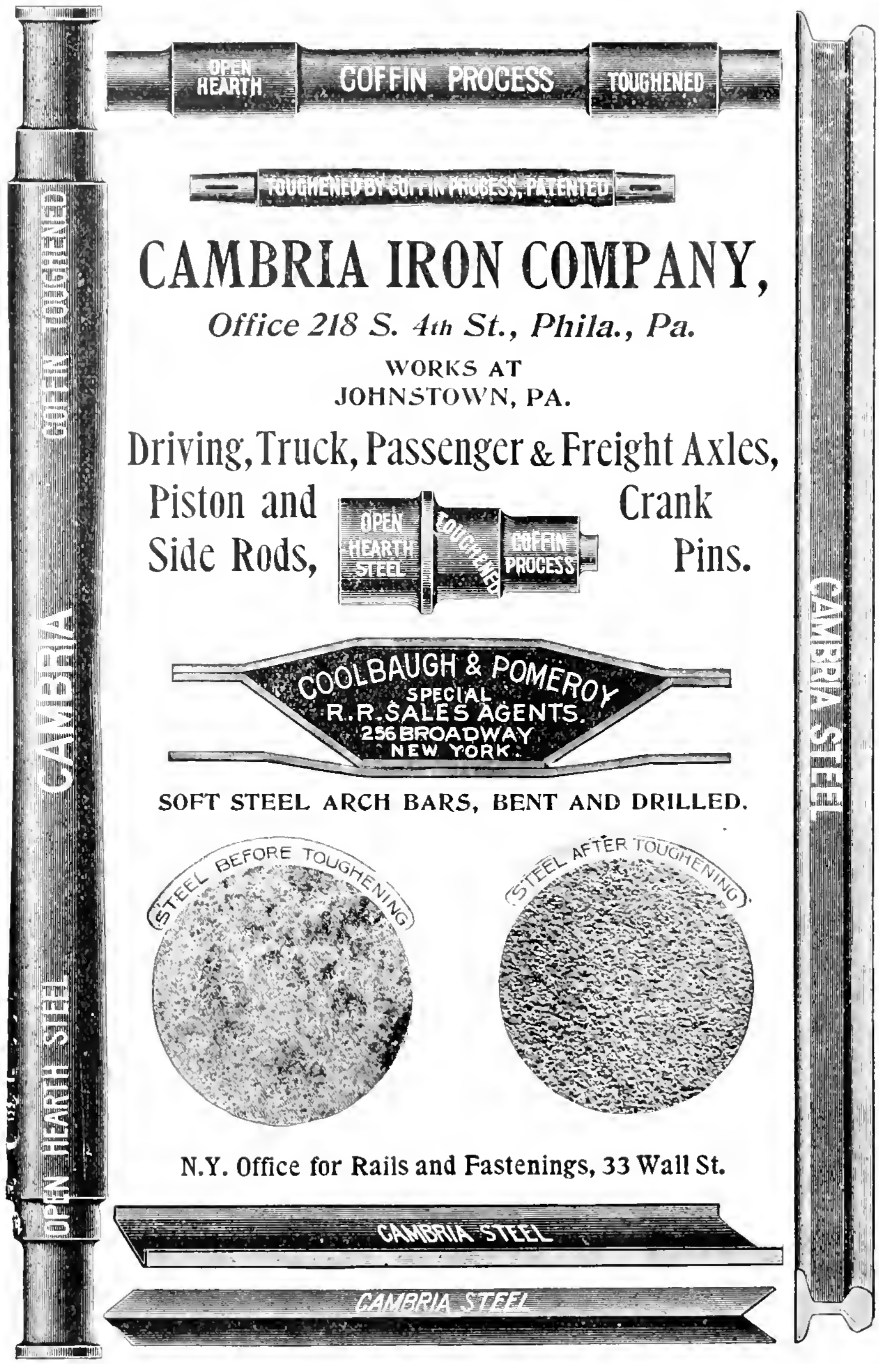

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FOR USE ON
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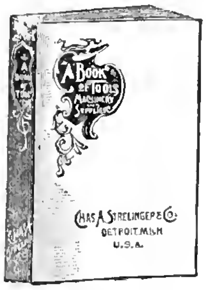

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We appreciate Mr. Dana's kindly letter, but beg to inform him and the readers of this journal, that we do not sell our "Book of Tools." If we sold them, we should have to charge more than a dollar to make any profit. These books, though unostentatious, cost us more than a dollar eac . We send them free to any address upon receipt of 15 cents, which barely covers mailing and advertising expenses.

Our object in printing and issuing this book is to get it into the hands of buyers of Tools, Supplies and Machinery, and thereby promote our business and increase our sales in the lines represented.

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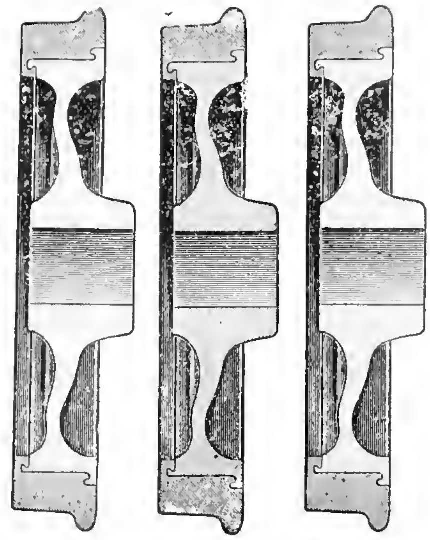

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A Wrought Iron Center,—a Steel Tire—and Nothing Else.

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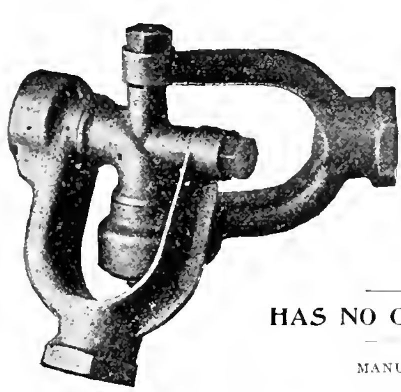

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Flexible Steam Joint

Does away entirely with Rubber Hose for Steam Heating

HAS NO GROUND JOINTS.

MANUFACTURED BY

The Hampson Flexible Steam Joint Co., Lakeport, N. H.

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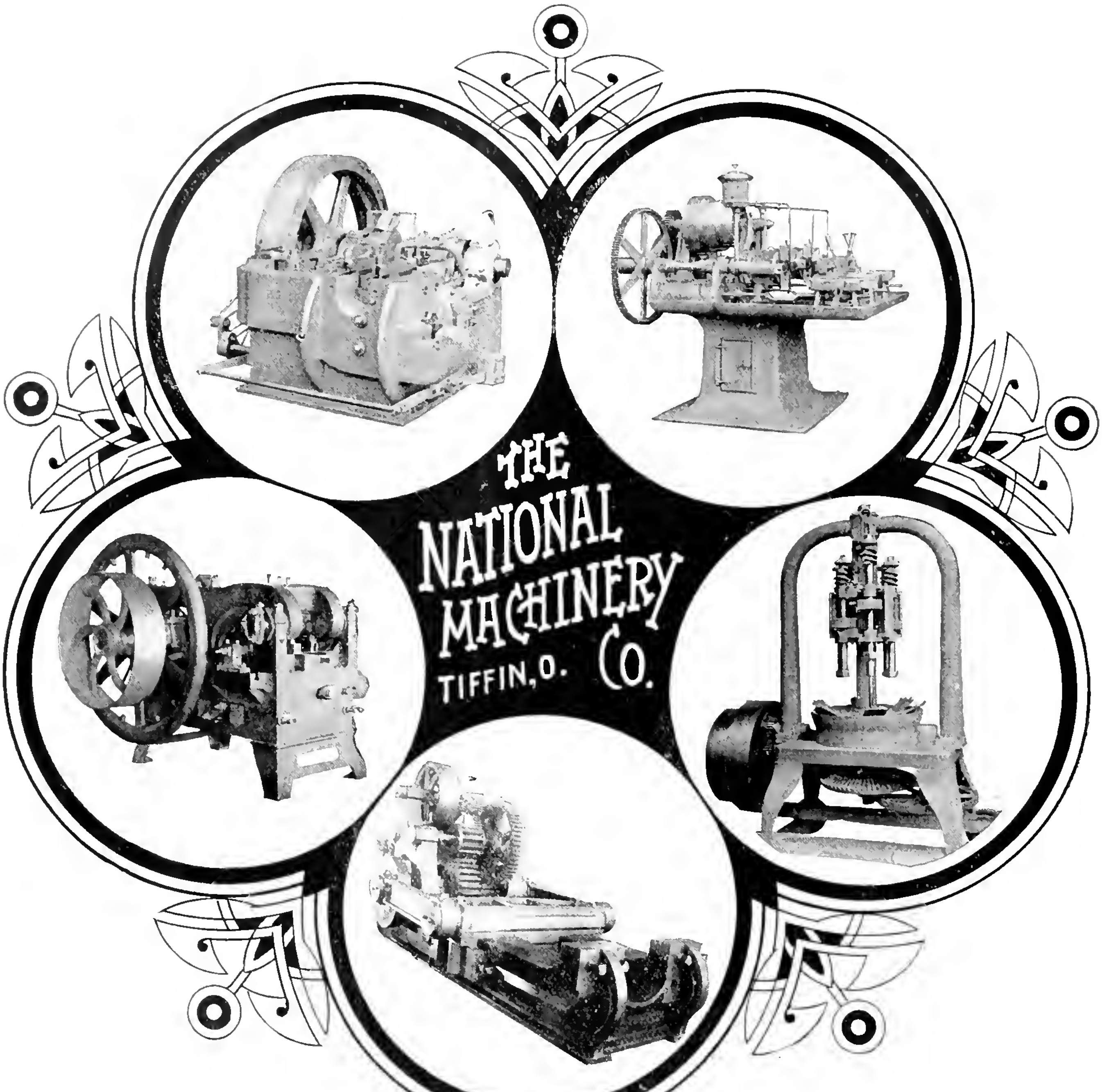

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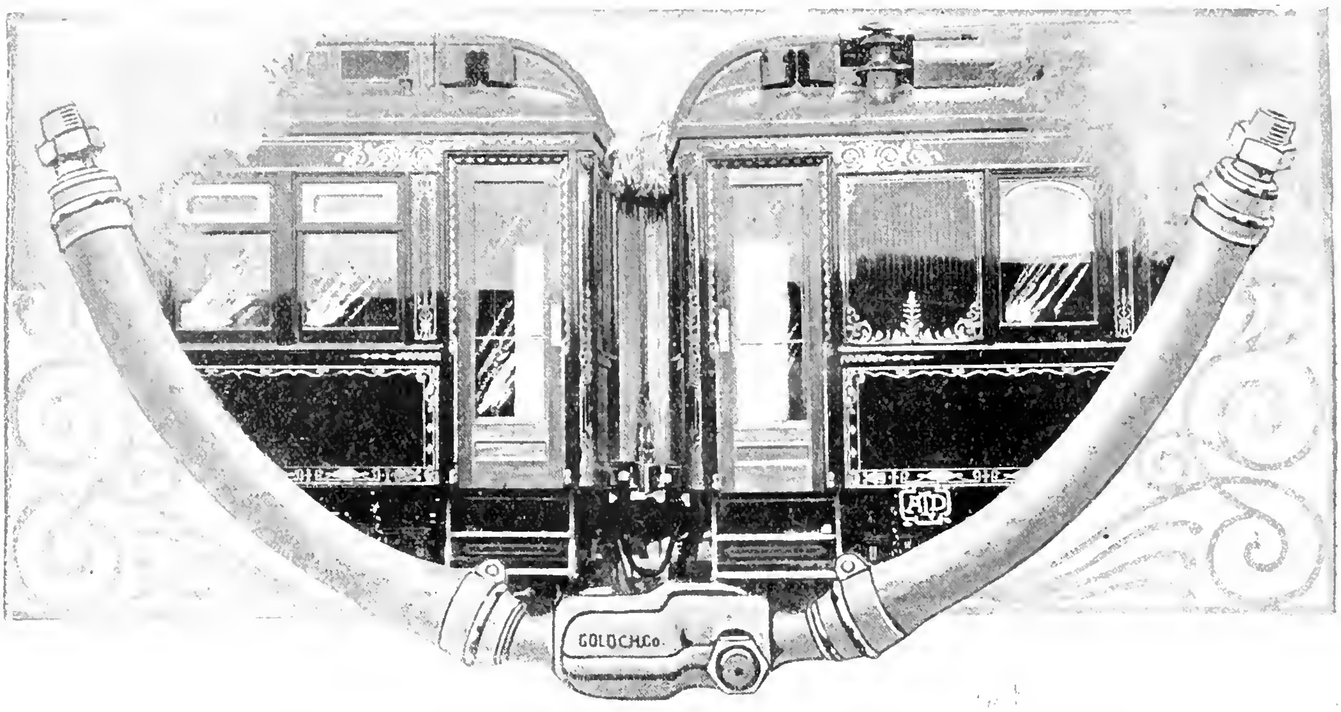

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Storage Heaters with heat storage fluid in hermetically sealed tubes. Storage Heaters with inner heat storage body of earthenware or terra-cotta. Duplex Double Coils for use with Baker Heater hot water circulating system, with or without jet system. Direct Steam with plain piping.

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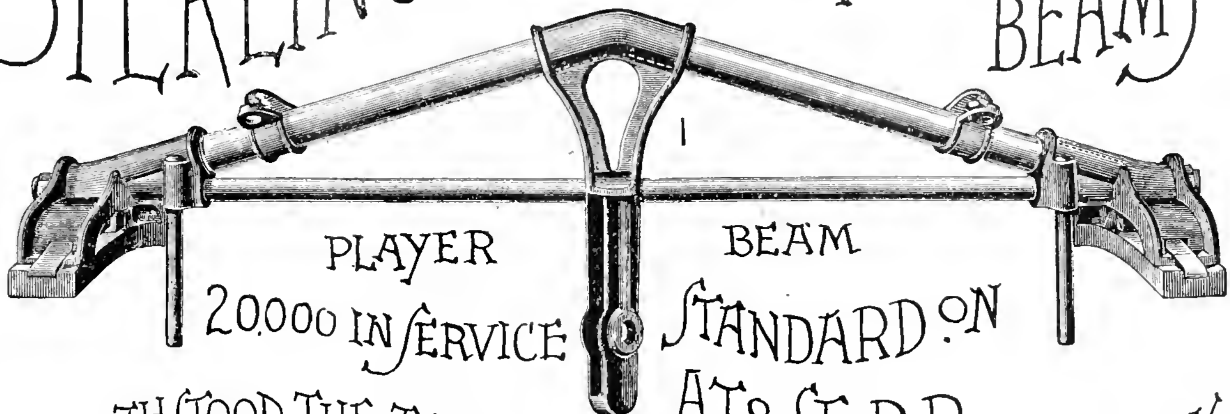

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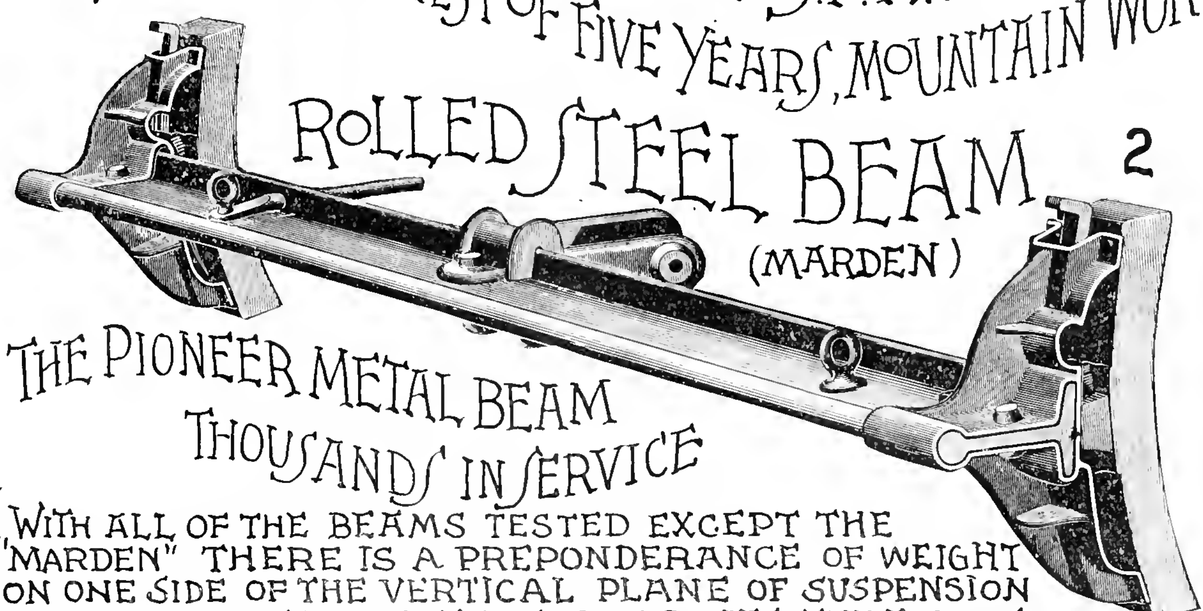

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"WITH ALL OF THE BEAMS TESTED EXCEPT THE "MARDEN" THERE IS A PREPONDERANCE OF WEIGHT ON ONE SIDE OF THE VERTICAL PLANE OF SUSPENSION WHICH CAUSES THEM TO TIP AND PERMITS THE TOP OF BRAKE SHOES TO RUB AGAINST THE WHEELS, ETC. M.C.B REPORT 1889 PP. 119

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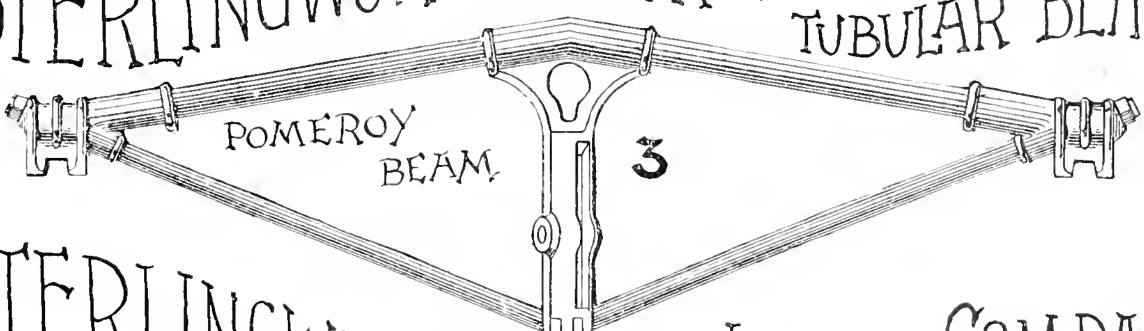

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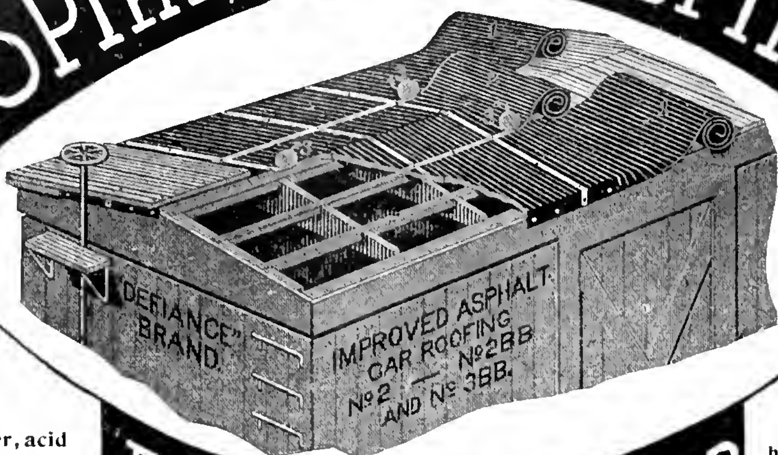
ASPHALT CAR ROOFING.



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Strong, flexible; water, acid and gas proof.

Protection against fire.

Adapted for cars, railroad buildings and all other roofs.

No coal tar or petroleum residuum.

Send for our new pamphlet, samples and prices.
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What Users Say:

"It is all O. K., or would not have just sent you an order."
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"We have decided to use your "Defiance" No. 2 Roofing, because what we have a ready used has been satisfactory."
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These are Cups hammered out from pieces of Boiler Tubes, and will be shown at the Convention, at Alexandria Bay.

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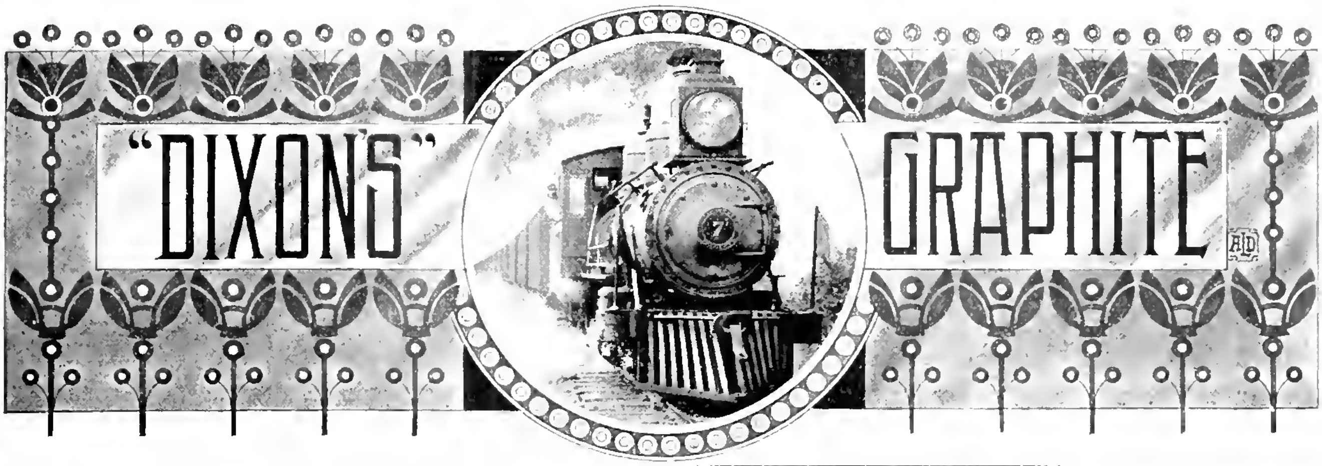

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Gentlemen:

I have run my engine in heavy freight service 115,000 miles with slight running repairs. It is good for 20.000 miles more before engine will have to be taken in shop for general repair. The valve motion is but slightly worn when compared with engines of same class in like work. The engine is noted as a "puller" ***on heavy grades,*** economical in fuel and oil, and has often been commented upon by officers, train dispatchers and trainmen and believed to be a superior built engine ***This is not the case. The secret of success is the daily use of Dixon's Graphite*** which gives a bright polish to valves, pistons and cylinders The graphite greatly reduces friction and gives a free and easy action to valve motion, which also accounts for the slight wear spoken of. This road has several heavy grades, and it is a common occurrence for engines to "stall" on these grades Whenever I have an unusually heavy train, and before approaching such grades I give each valve about two (2) tablespoonfuls of oil and graphite. I have never known it to fail, and it is really wonderful with what ease the engine goes over these hills. Valves work free and easy and the reverse lever can be held with one hand, even when full boiler pressure is used.

This is not generally known, especially by our officials, as what graphite is used is purchased by the engineers. I have often thought of taking up this matter with our Master Mechanics, but being only an engineer I have come to the conclusion that such a course would be unwise and result in no good, even though I could refer to the mileage and condition of my engine as proof of what I claim for graphite.

AN EXPERIENCED ENGINEER

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FOR WELDING, TEMPERING, BRAZING & HARDENING.

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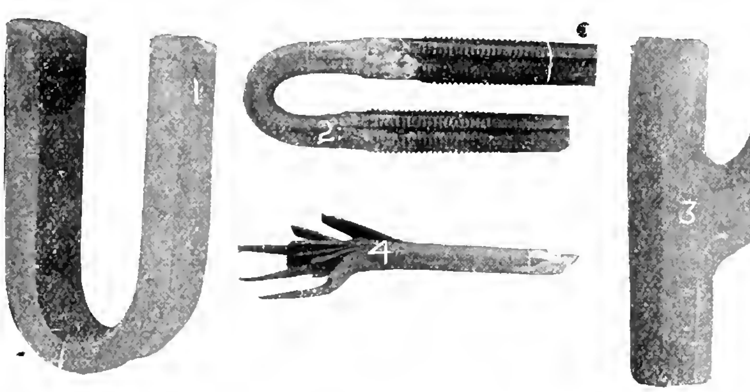
A piece of Crucible Steel, lap welded and bent in the weld by several blows of the sledge.

2
Two old screw taps of different grades of steel, 20 years old, welded together and bent over horn of anvil to show solid weld.



3
A piece of Black Diamond steel jump welded together, then struck with several blows on upright piece with sledge, to see if weld could be drawn off.

4
Six old American files welded together solidly at separate heats, obliterating trace of teeth. After weld was made they were doubled back in the center and drawn down under hammer into a solid bar of tool steel.

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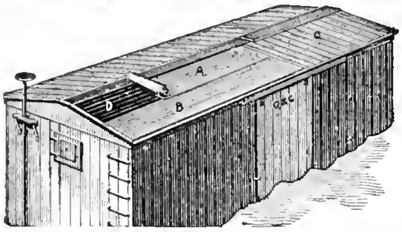

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THE COMING ROOF!

HEAVY, DURABLE AND STRONG.
WILL WEAR LONGER THAN ANY METAL ONE.

COSTS FROM $10 TO $15 LESS PER CAR.
CAN BE PUT ON IN ONE-HALF THE TIME.

WILL WEAR THE LIFE OF THE CAR.

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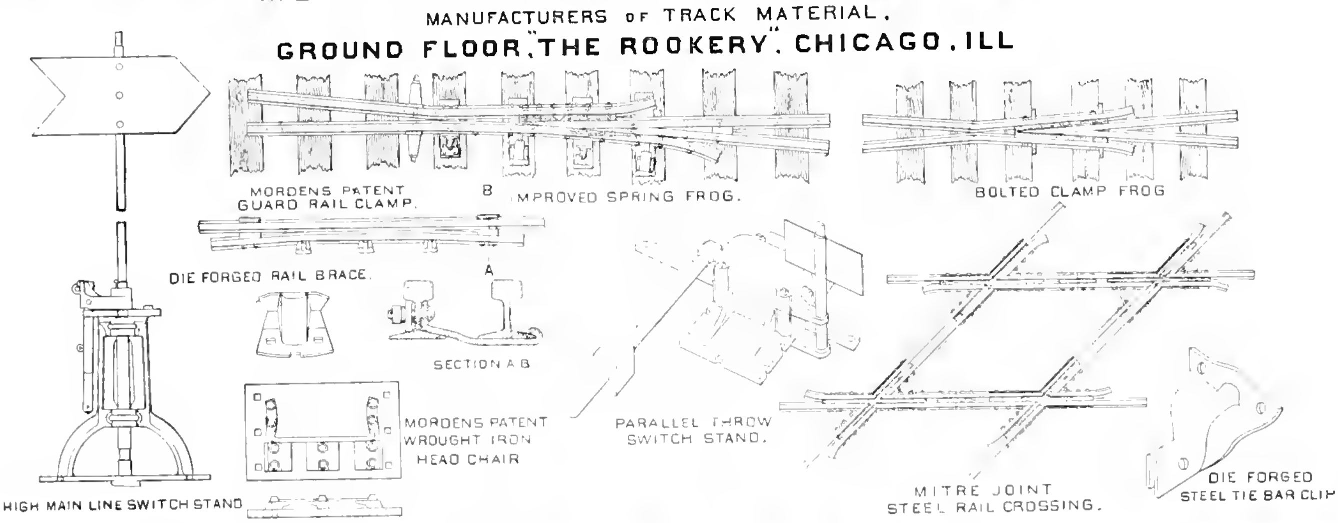

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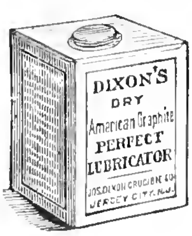

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An engineer, whose engine has run 115,000 miles with slight running repairs, is noted as a "puller" on heavy grades, economical in fuel and oil, and often commented upon by officers, train dispatchers and trainmen, and believed to be a superior built engine, says, "The secret of success is the daily use of Dixon's Graphite, which gives a bright polish to valves, pistons and cylinders."

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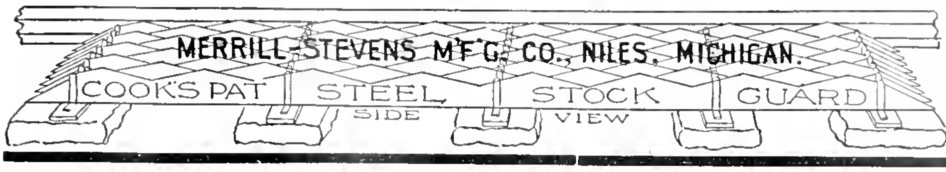

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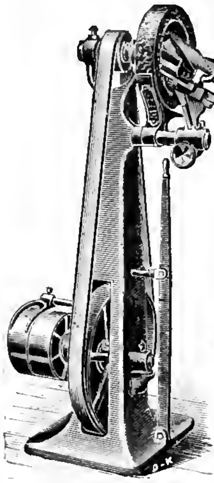
Book costs a postal.

Our Guards will Save your Company Money.



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GRINDER

This machine grinds all sized drills, from 1/8 to 2 1/4 inches. Set for any size in two seconds. Gives the proper clearance and can't grind a drill wrong. Address,

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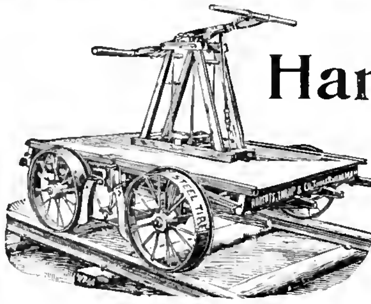

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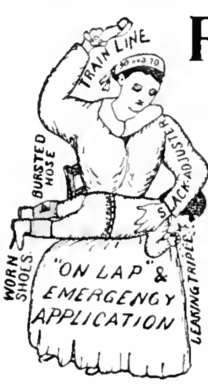

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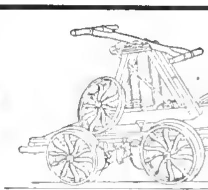

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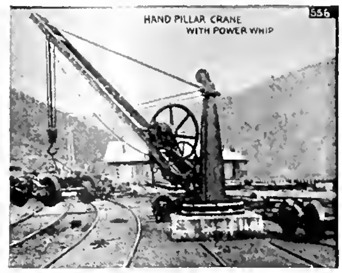

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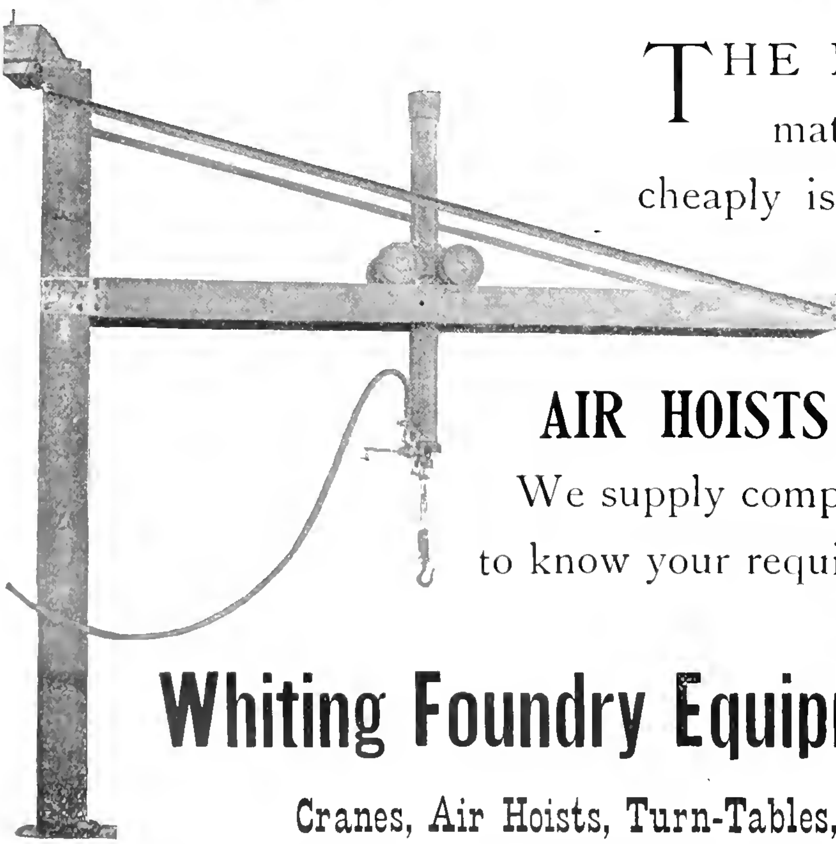

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ONE POINT OF EXCHANGE.

Name of Couplers.	Couplers Interchanged.	Castings Broken or Gone.	Per Cent.	Knuckles Broken or Gone.	Per Cent.	Uncoupling Devices Out of Order.	Per Cent.	Average Per Cent. for 1894.
Chicago..	9176	449	.0489	486	.0530	716	.0780	$5\frac{99}{100}$
California	980	66	.0673	76	.0776	102	.1041	$8\frac{1}{3}$
Drexel...	2962	124	.0419	153	.0517	227	.0766	5 [illegible]
St. Louis.	8823	336	.0381	460	.0521	704	.0798	5 [illegible]
Hinson...	105114	1135	.0108	1216	.0116	1678	.0160	$1\frac{28}{100}$

The Chicago, California, Drexel and St. Louis are Open Hearth Steel Couplers.
The **Hinson** is a Malleable Draw Head, with Open Hearth Steel Knuckle.
On basis of \$20.00 per car, cost of maintenance $25\frac{6}{10}$ cents per year.

It has been said "that figures will not lie."

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Evansville & Terre Haute.
Illinois Central.
Indiana, Illinois & Iowa.
Kansas City, Fort Scott & Memphis.
Kansas City Belt Line.
Lehigh Valley.
Louisville, New Albany & Chicago.
Louisville, New Orleans & Texas.
Long Island Railroad.
Louisville & Nashville.
Missouri Pacific.
New York, Chicago & St. Louis.
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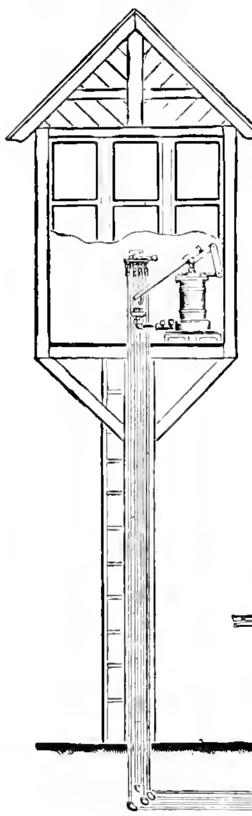

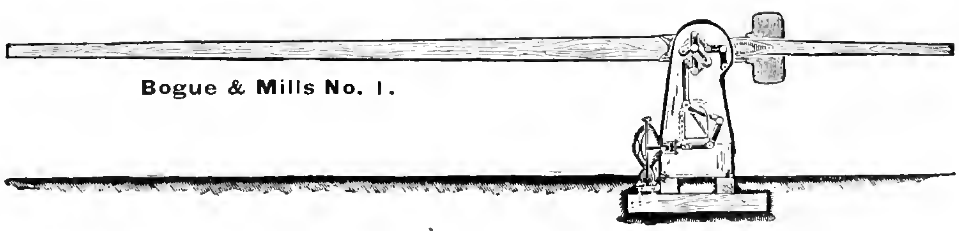

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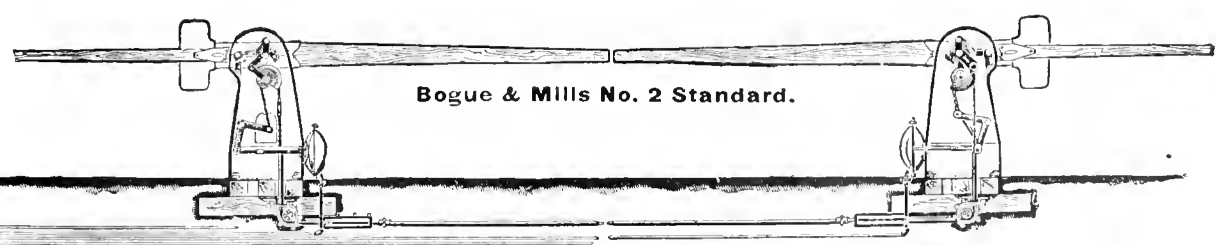

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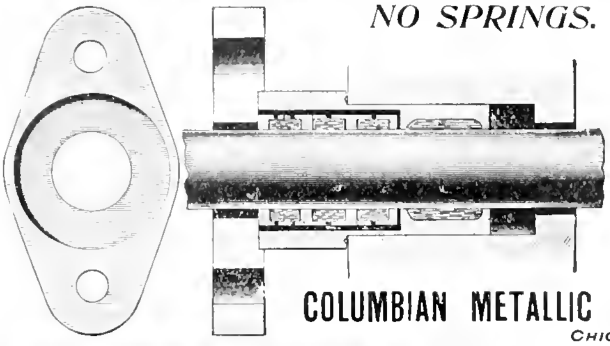

Friction next to nothing. Protracts Life of Rods. Three Rings for Heavy Service. One Ring for Passenger Engines. *Will Contract to provide this Packing for Half Cost of using Flexible Packing.*

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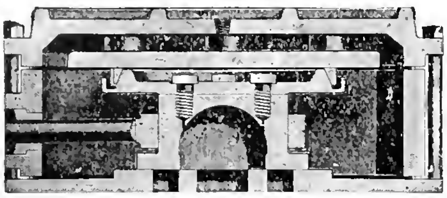

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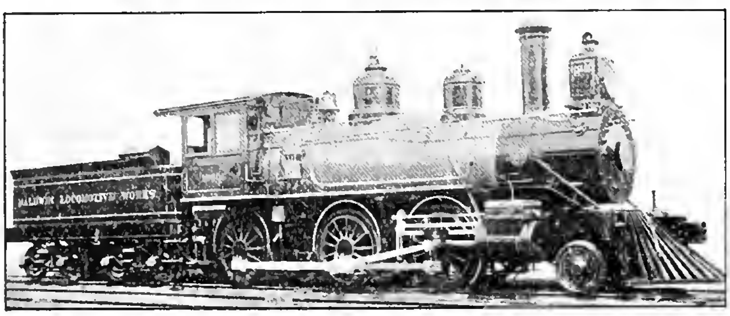

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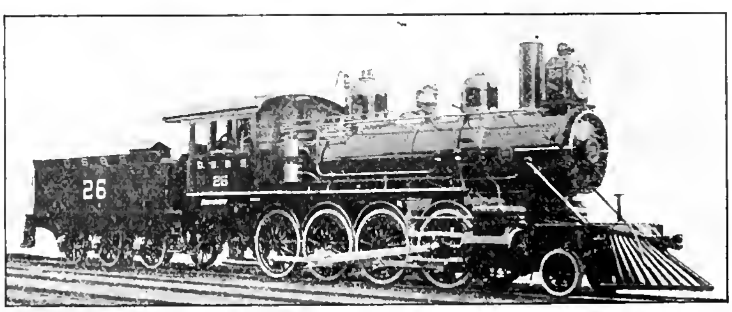

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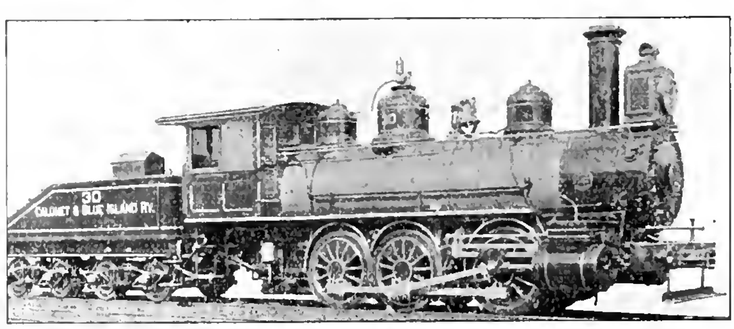

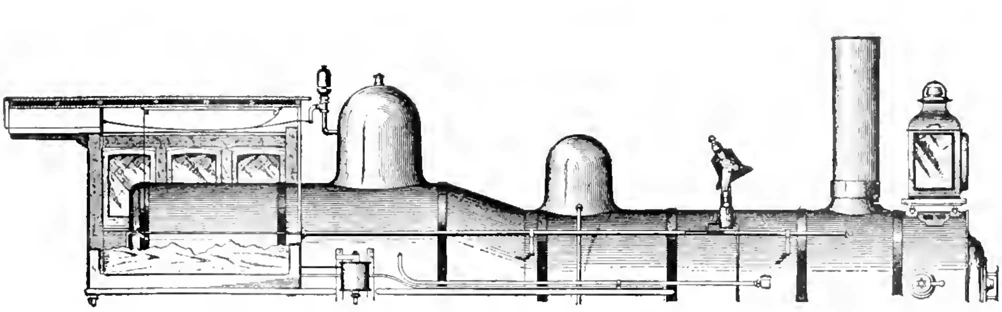

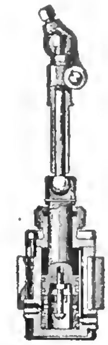

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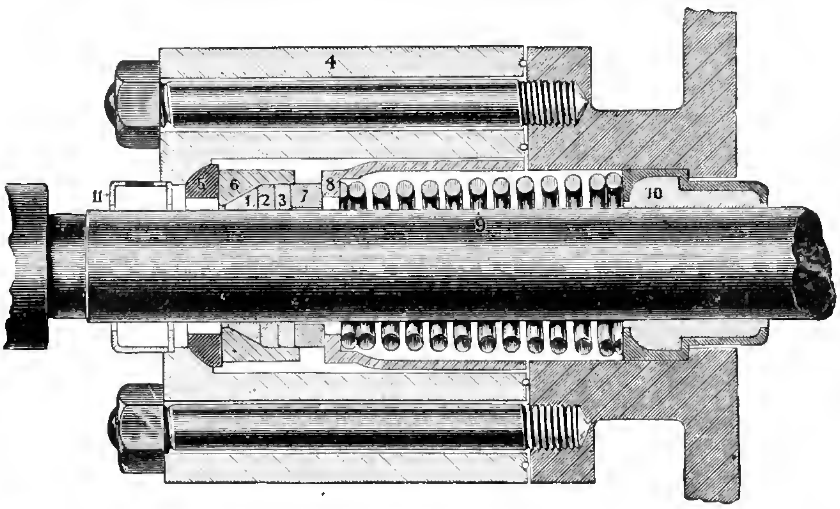

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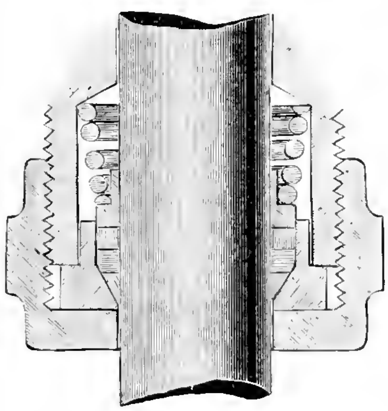

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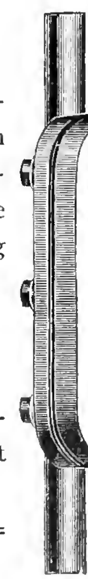

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Is daily proving the Handiest, Strongest and Best Wrench

IN THE WORLD.

Grips quickly and firmly *galvanized* as well as other pipe, *and will not crush it. Releases instantly. Cannot lock on pipe.* Has scale to set wrench to size before placing on pipe.

Can be easily sharpened on grindstone or emery wheel—without taking apart. Costs less for repairs than any other Pipe Wrench. The jaws are smooth and parallel, *and will not mar a nut or highly polished fitting.*

The entire wrench is drop forged from Crucible Steel, and the jaws are hardened.

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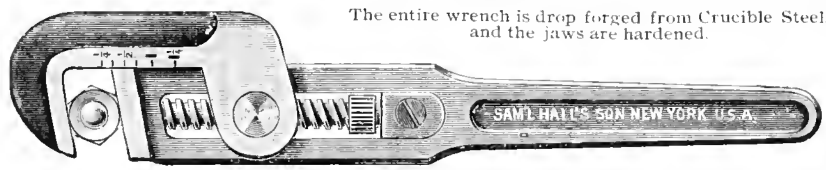

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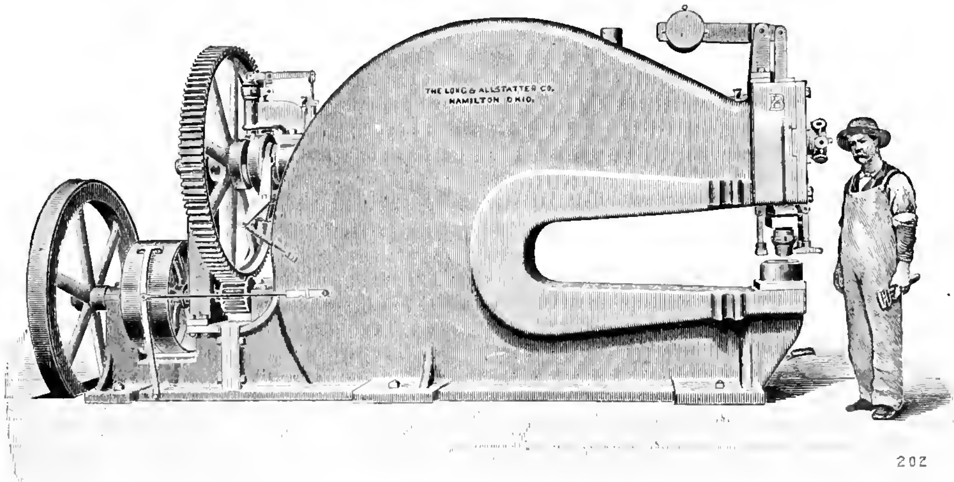

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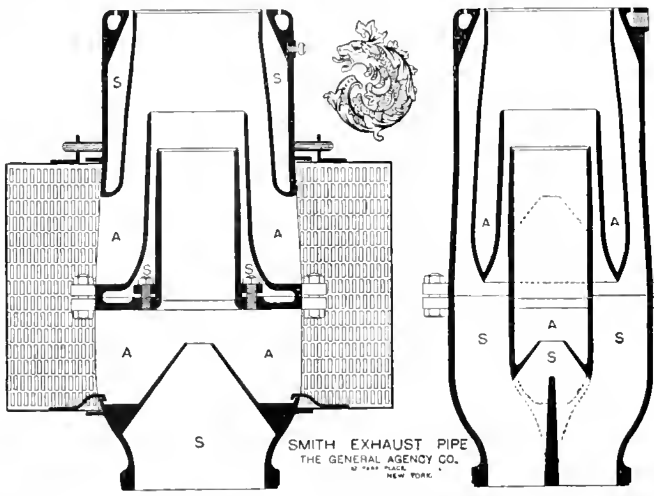

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A few Guaranteed Beneficial Results obtained are:

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The Smith Exhaust Pipe Co.
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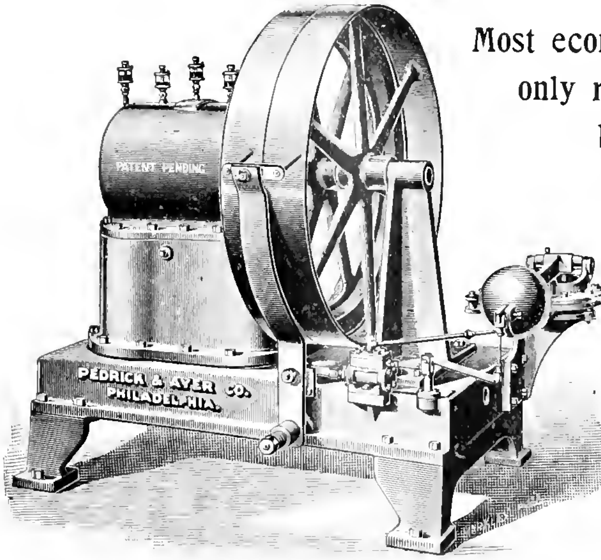

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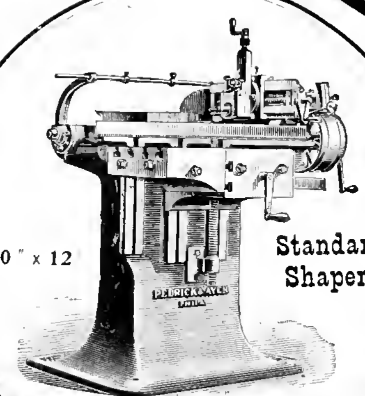

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That Standard Shaper is the best thing out — a NEW principle — cuts sidewise. Easiest to set work. Stroke changed at full speed.

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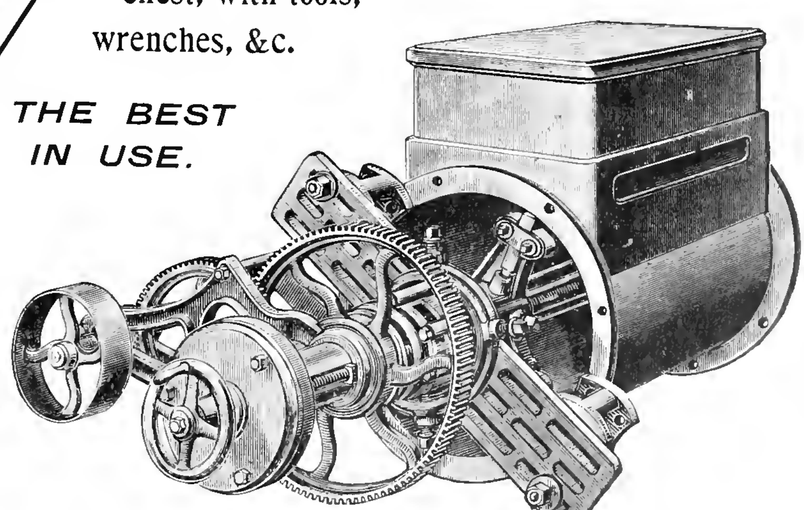

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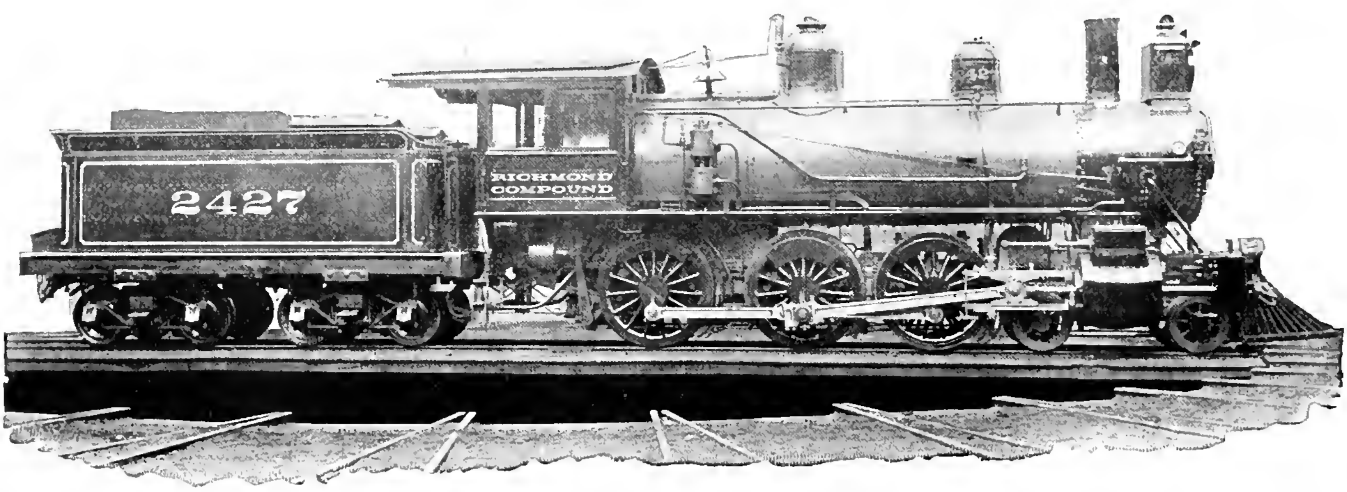
Simple or Compound, for every Variety of Service.



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Work Guaranteed Second to None.

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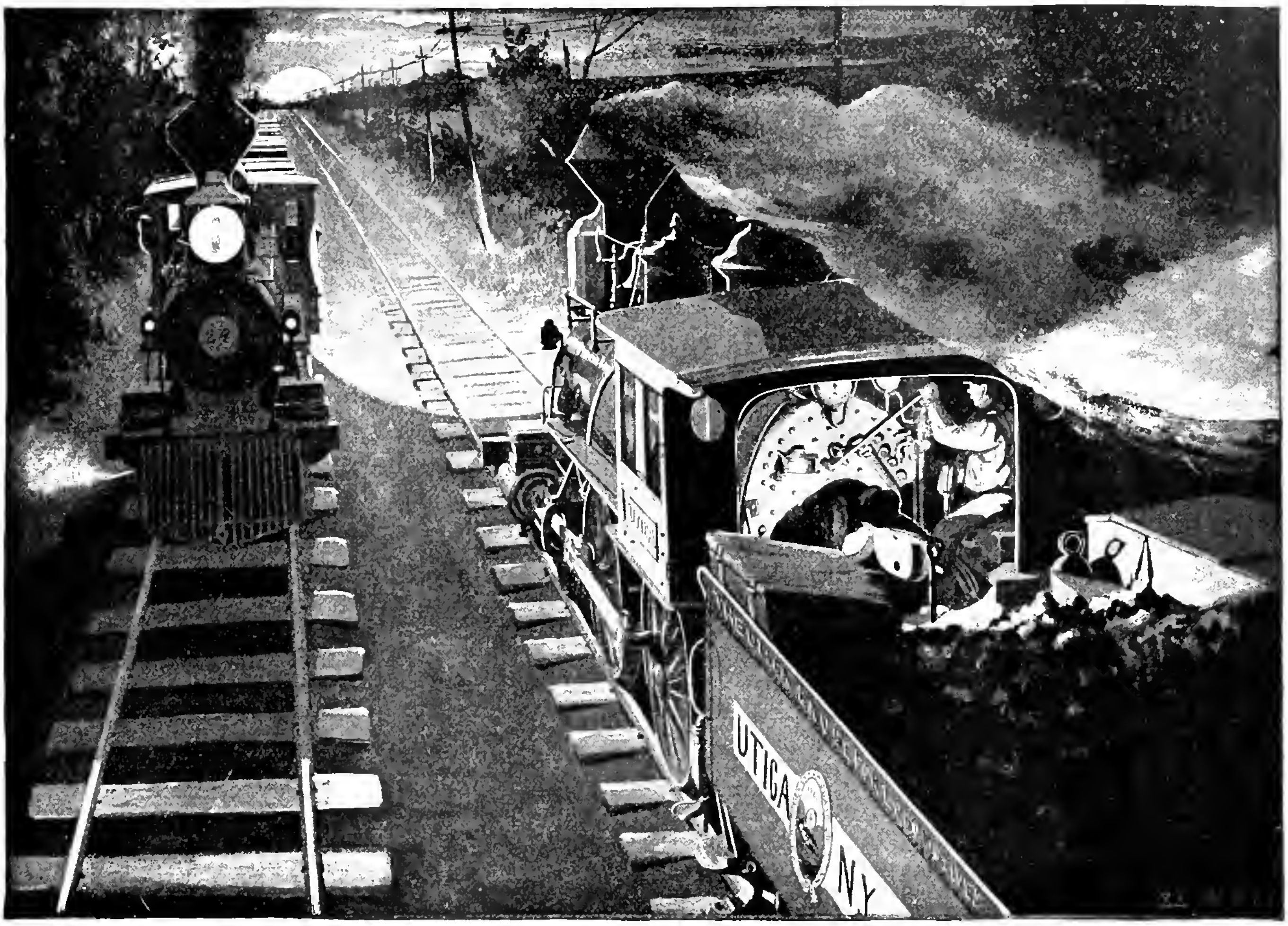
The "Old Reliable" Utica Gauge.



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HAS been "on the road" over 30 years, and while **it is not** the **only** Locomotive Gauge having all mechanism free from the back of the case, it **was** for years.

"UTICA" Gauges for Pressure, Compound, Cab and Car (heating), Air-Brake, Tests, etc., are not the cheapest but the BEST, and backed by a record, experience and a reliable guarantee.

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This company controls in the United States the celebrated Pintsch system of car lighting. It is safe, efficient, economical, and approved by both railway managers and patrons, and has received the highest awards at the World's Expositions at Moscow, Vienna, St. Petersburg, London, Berlin, Paris and Chicago.

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Car Heating Systems by Steam.

The superior jacket system in connection with the Baker heater.

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showing the most advanced ideas in Couplers, and in the general use of malleable iron in car construction.

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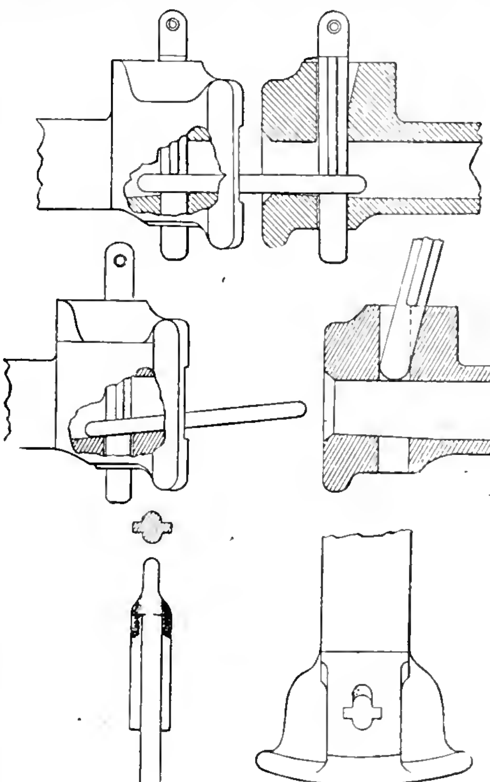

Sams Automatic Car Coupler

Possesses these features:

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Validity of Patent, and as to its meeting the requirements of the U. S. Law, has been passed upon by prominent Legal authority.

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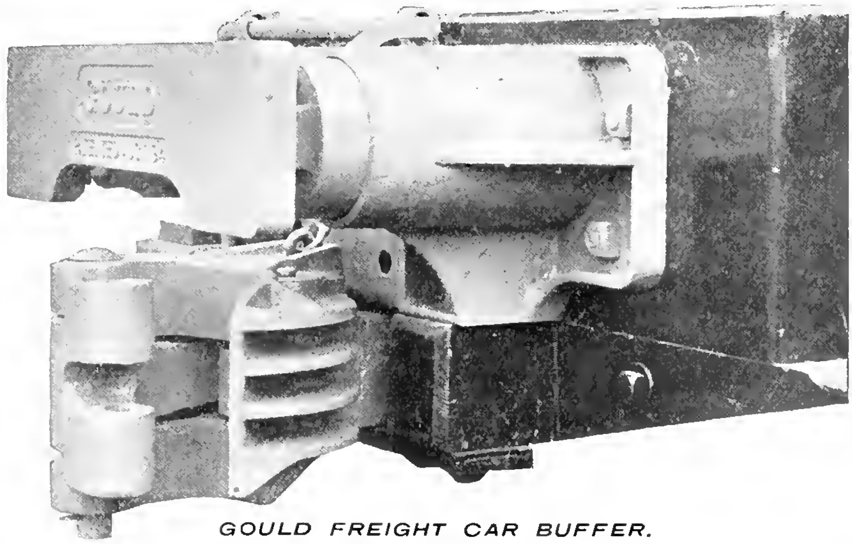

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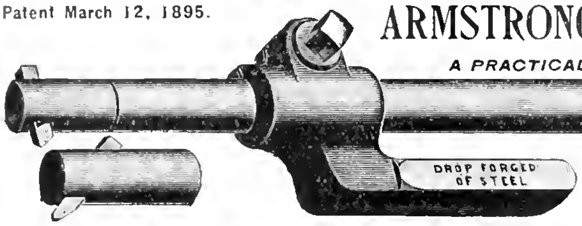

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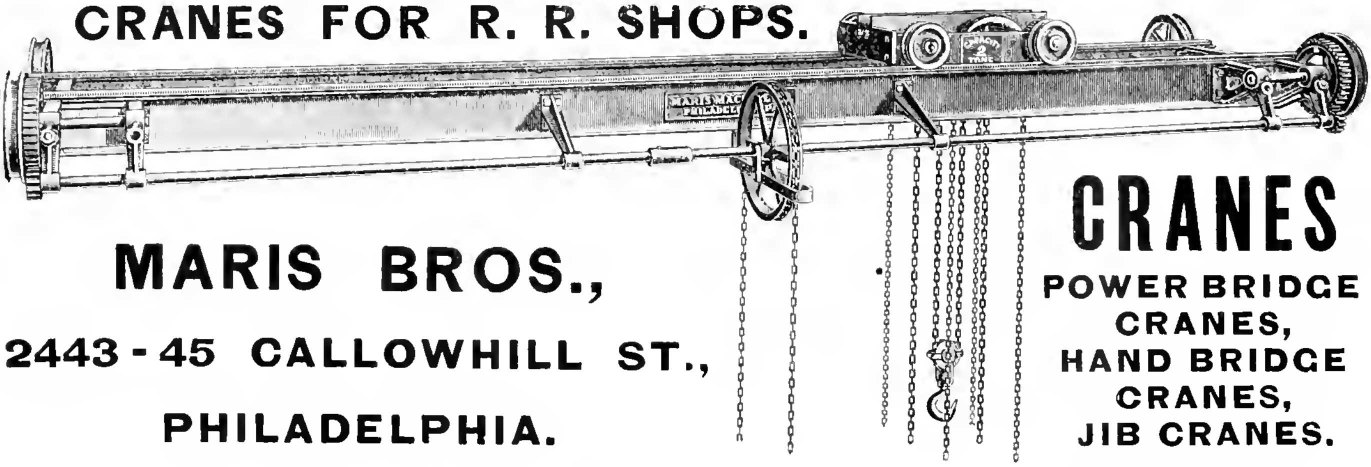

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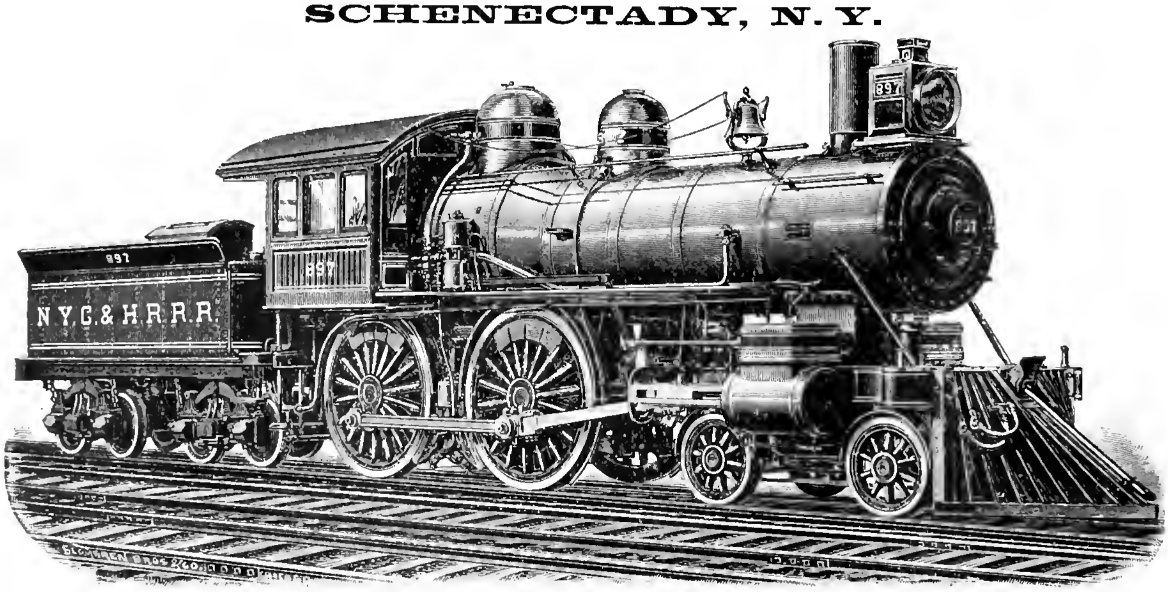

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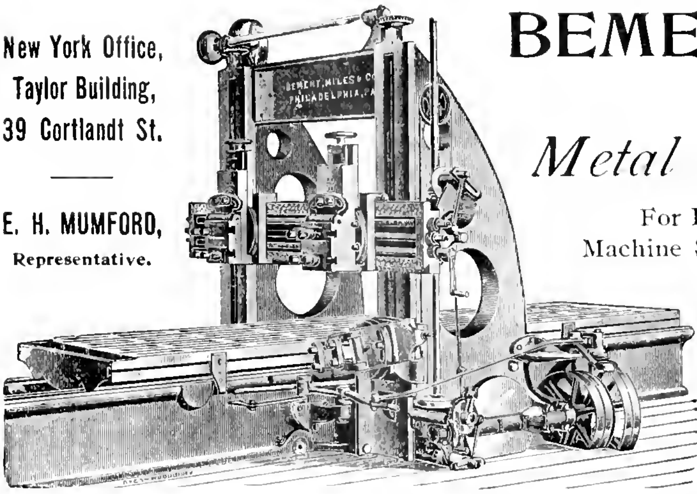

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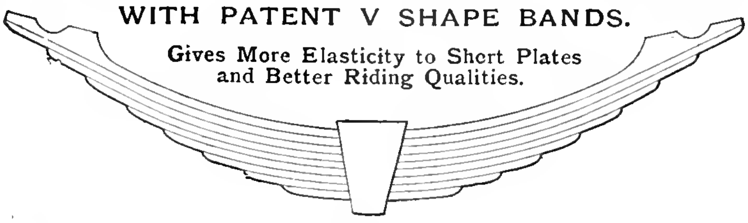

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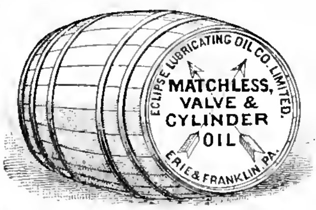

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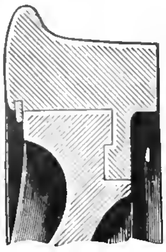

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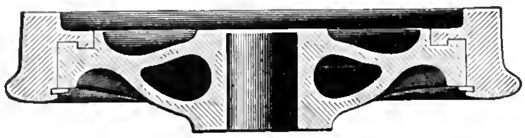

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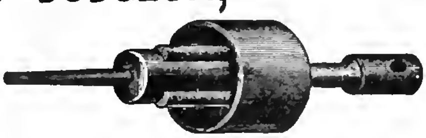

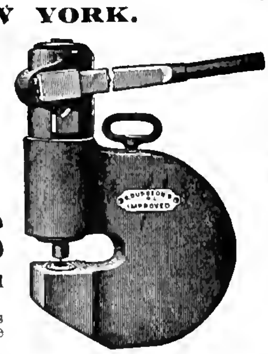

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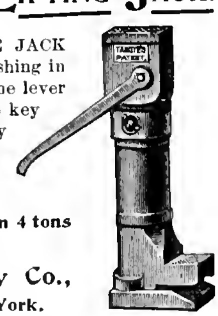

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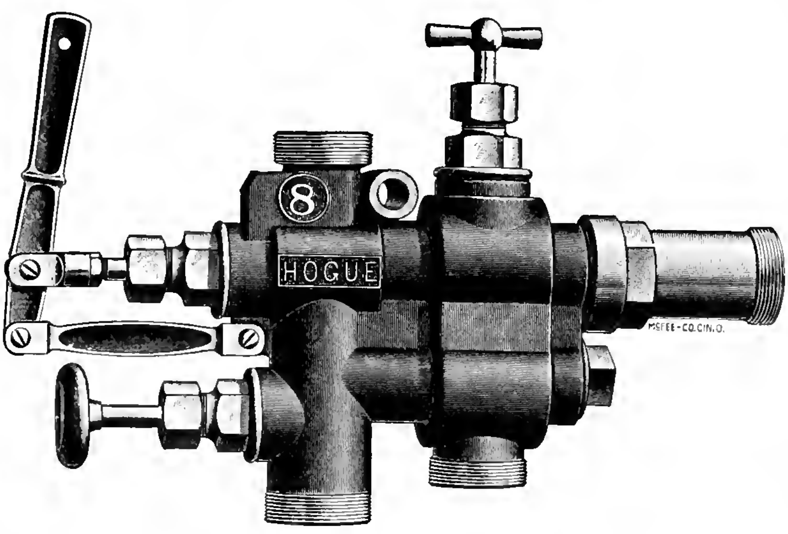

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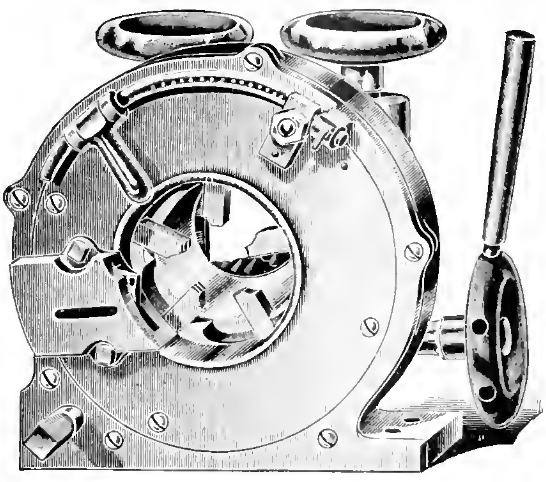

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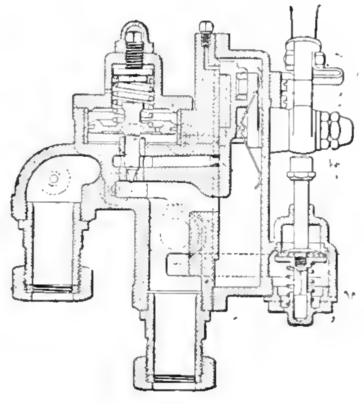

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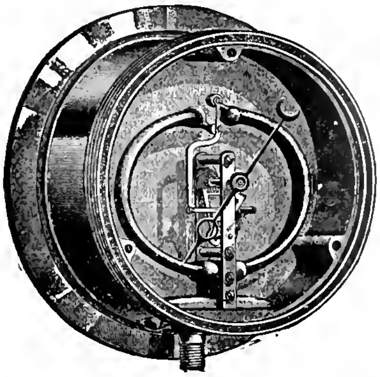

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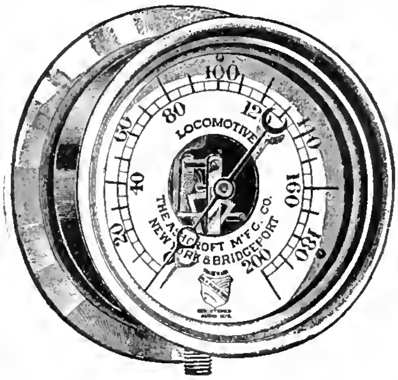

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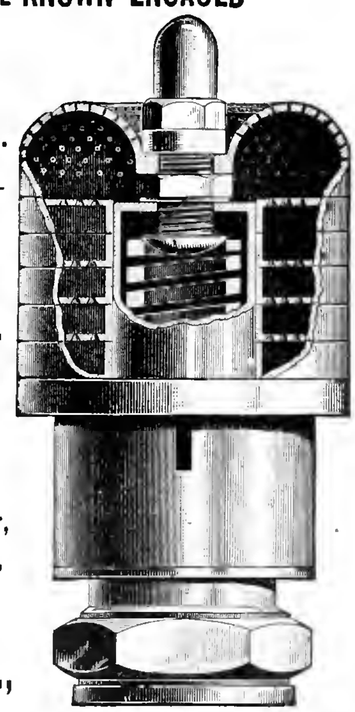

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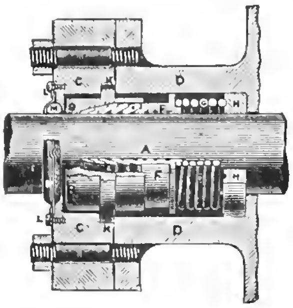

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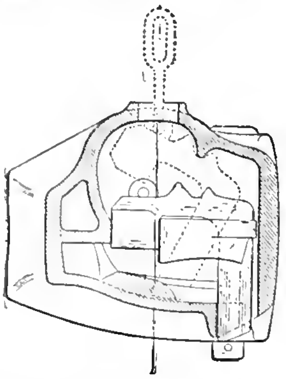

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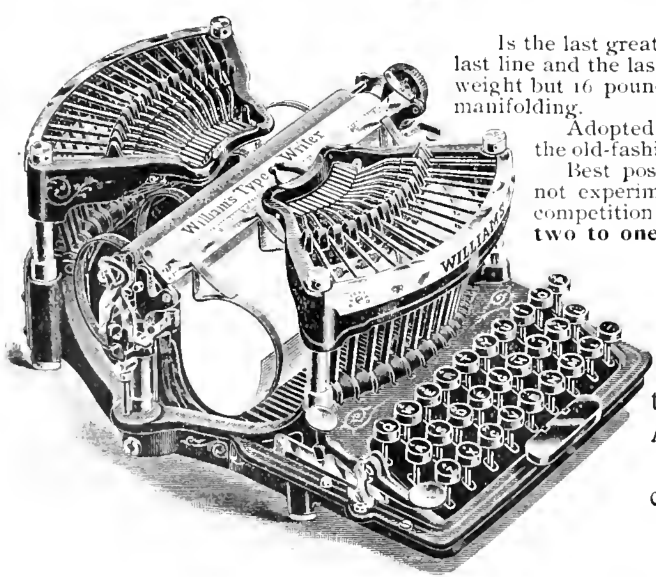

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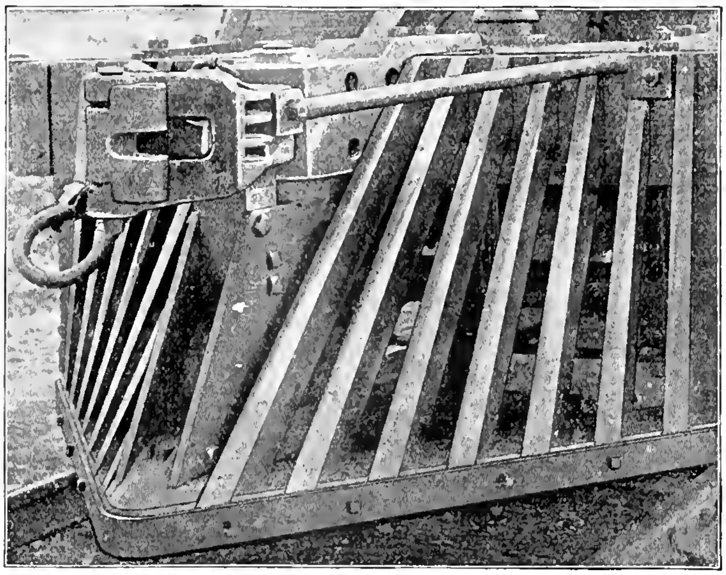

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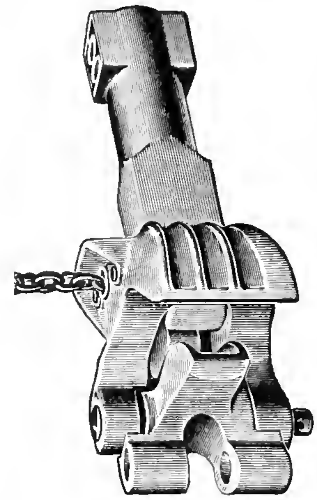

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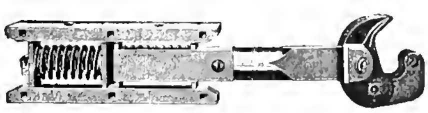

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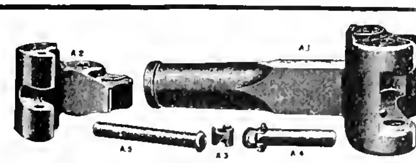

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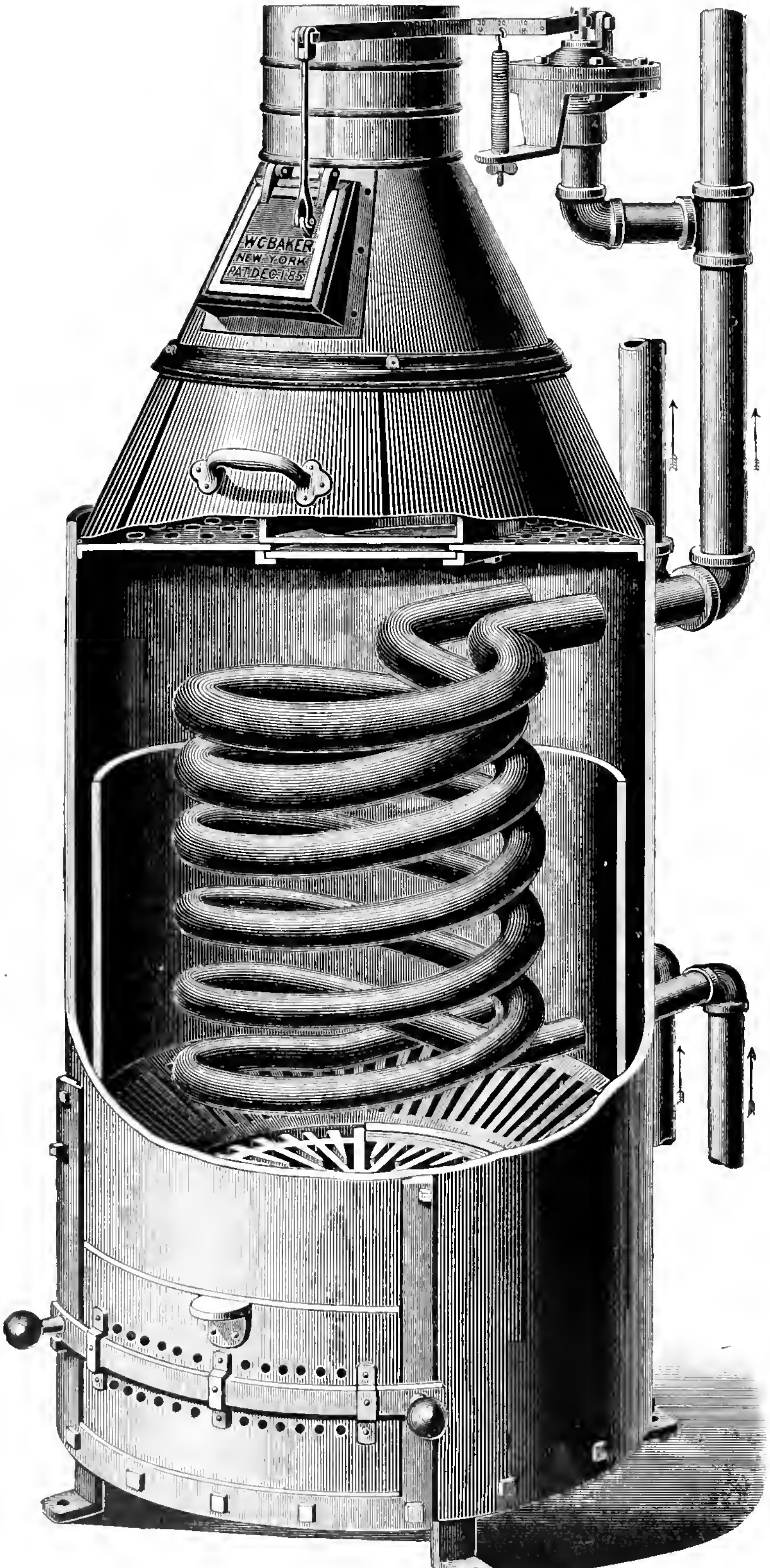

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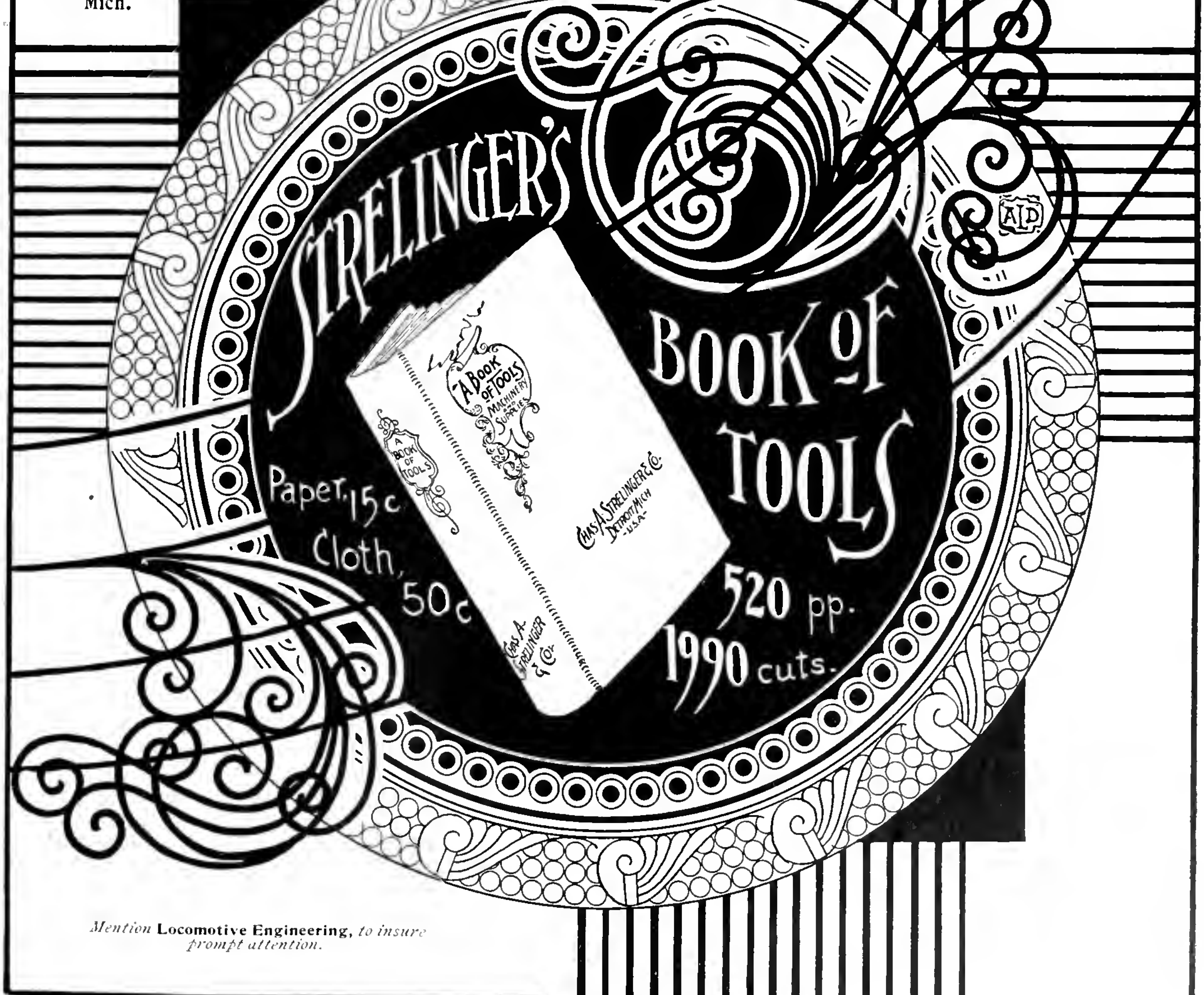

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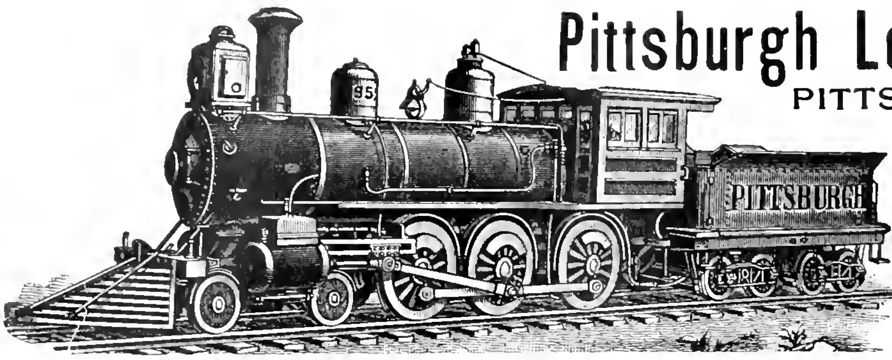

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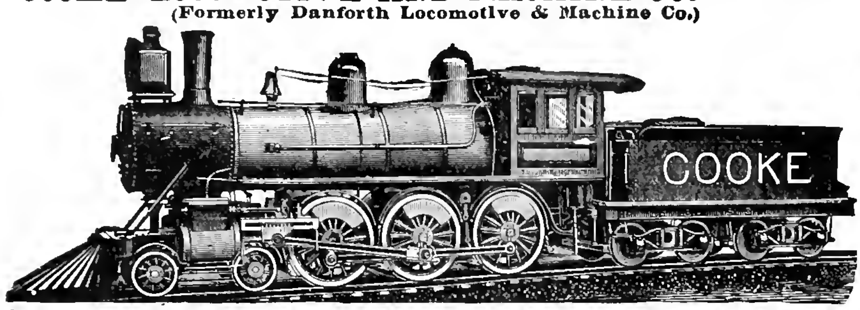

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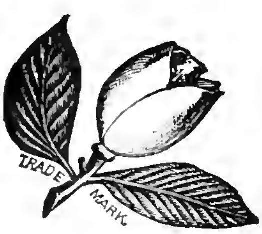

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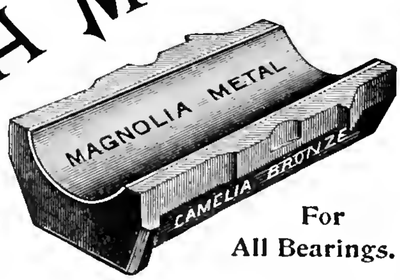

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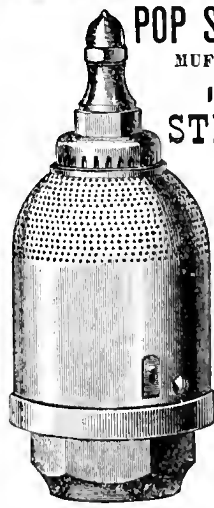

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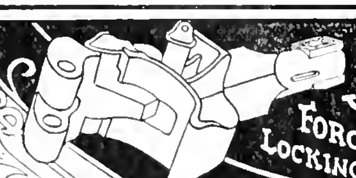

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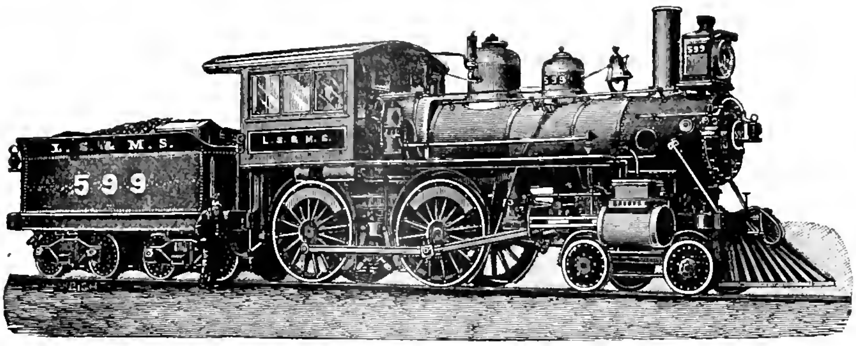

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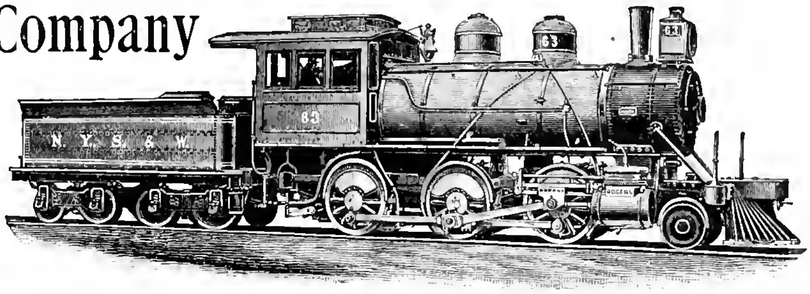

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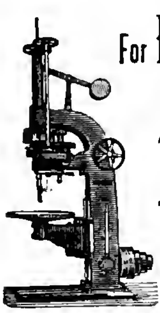

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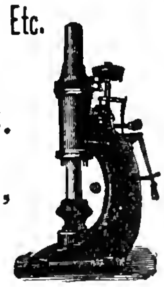

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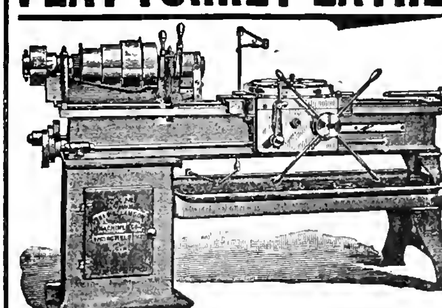

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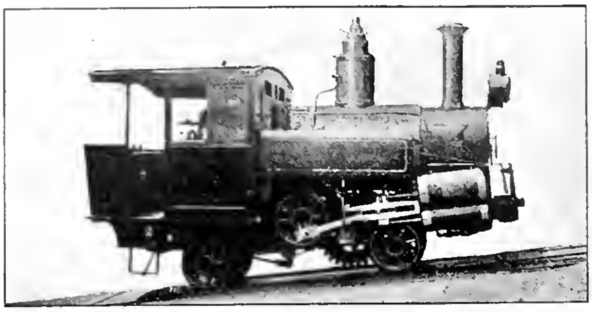

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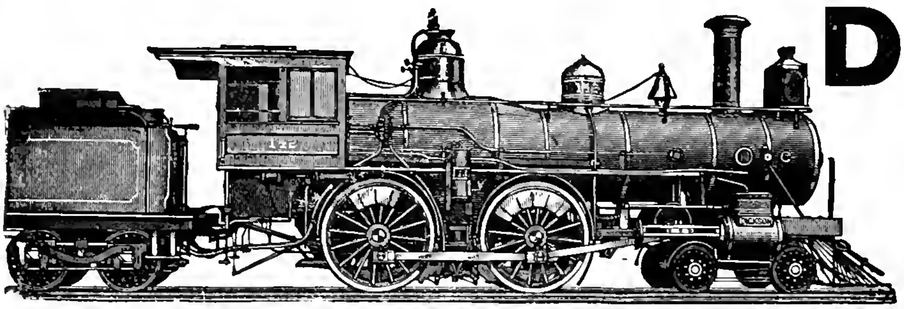

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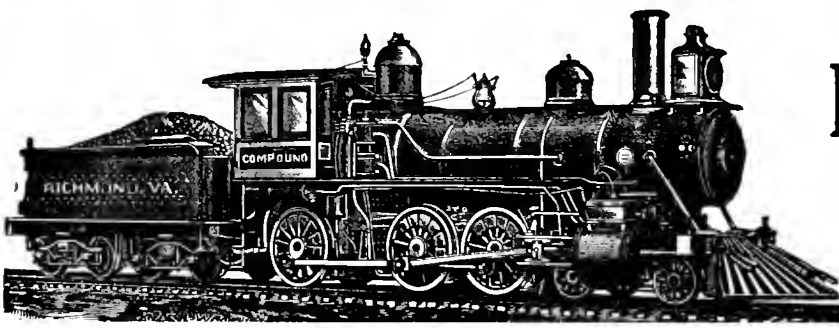

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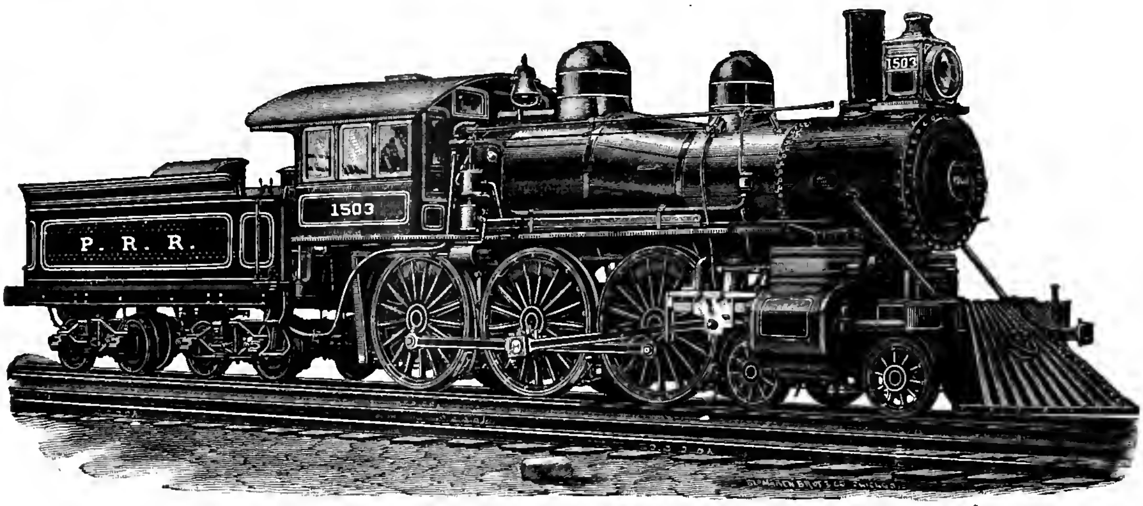

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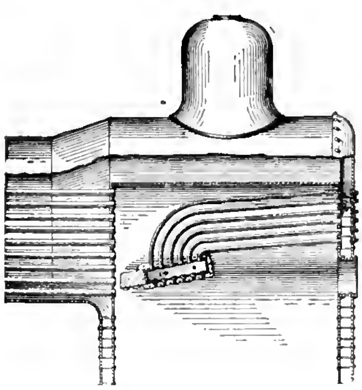

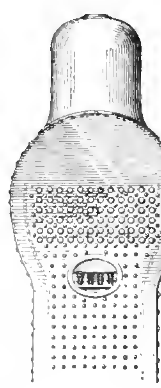

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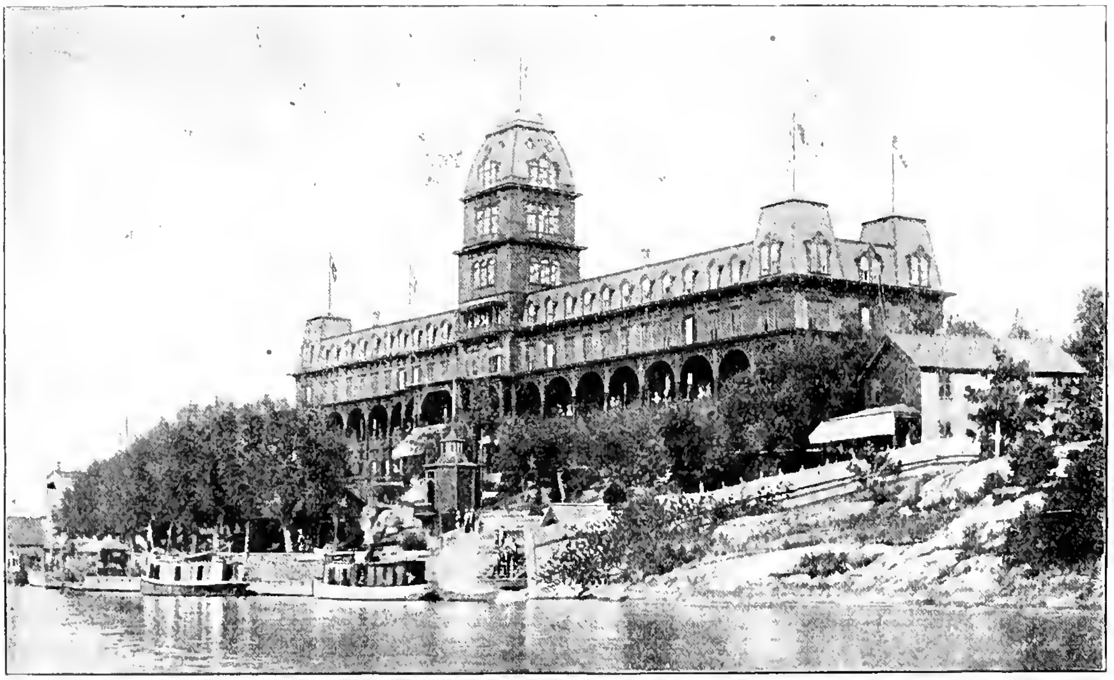

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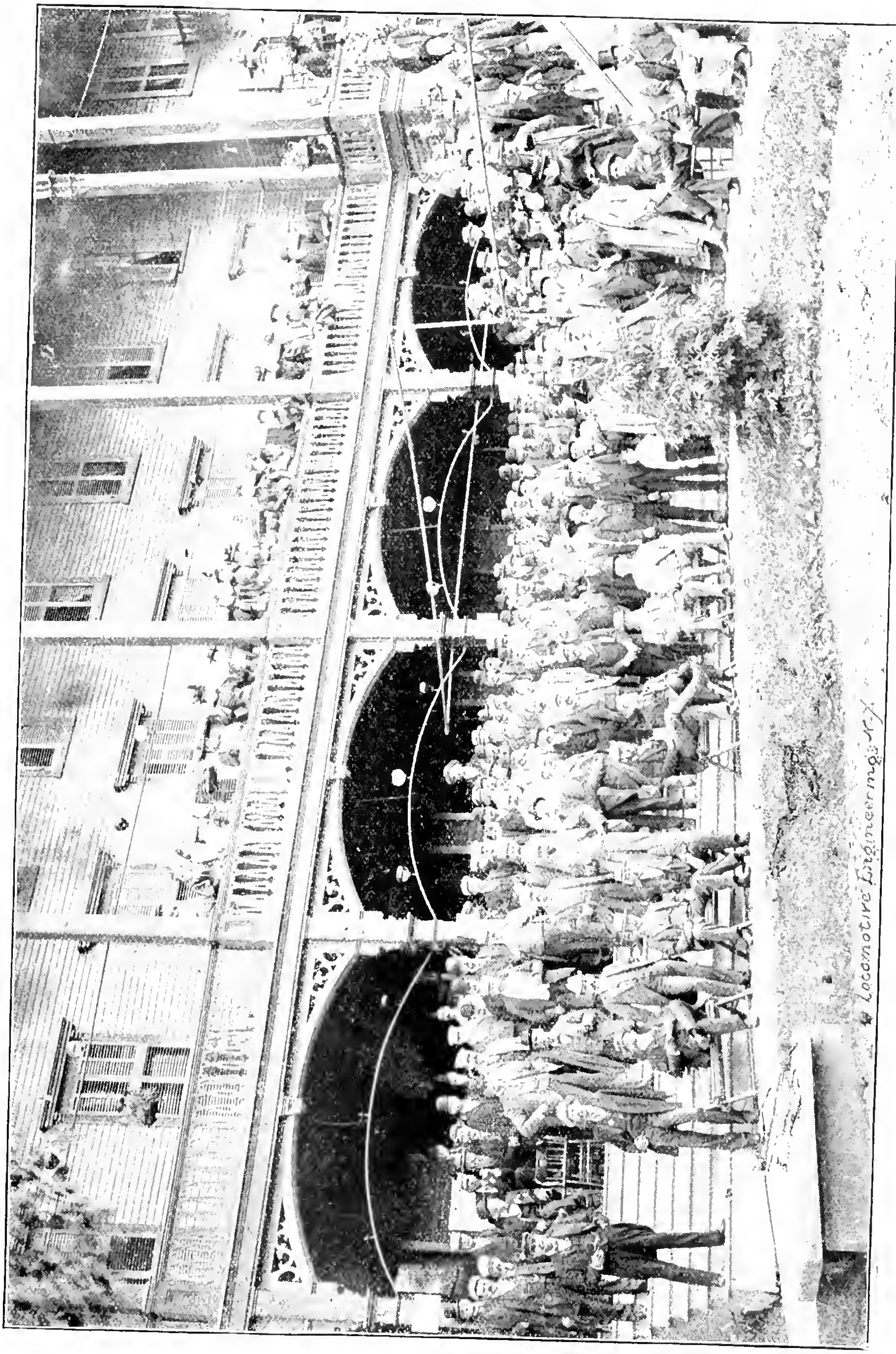


Group at Master Car Builders' Convention, Thousand Islands, June, 1895.

GROUP AT MASTER MECHANICS' CONVENTION, THOUSAND ISLANDS, JUNE, 1895.

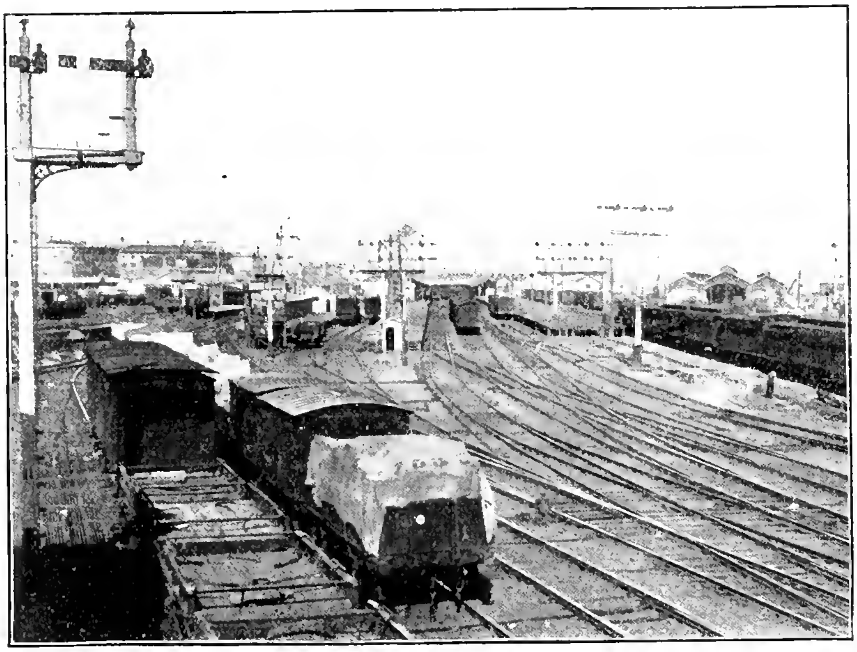
LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK
[Trade-Mark Registered.]
Vol. VIII. 256 BROADWAY, NEW YORK. No. 7.

When Steam Was the Master.

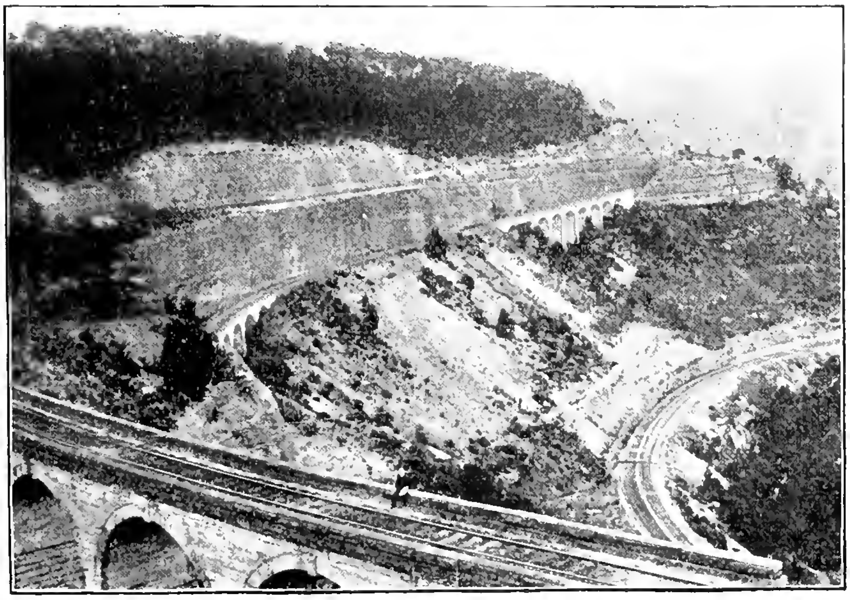
Among the questions that came to this office for answer last month was one asking if it was true that James Watt was the first person to discover the power of steam, and if the story was true that his attention was first turned to the subject by seeing the lid of his mother's kettle jumping under the force of the escaping steam. We have repeatedly told that Watt was not the inventor of the steam engine—merely an improver, but it is difficult to get all our readers to understand this. The story of the kettle is a myth, and is on a par with the story that Romulus was suckled by a wolf.

The expansive power of steam was understood long before our era began. There is good reason for believing that the pressure of steam was employed by the ancients in various ways, mostly to display mysterious phenomena. A simple form of steam engine was used in Alexandria more than 2,000 years ago.

Ewbanks, in his well-known book on hydraulics, says that "Steam has been



AUSTRALIAN RAILROAD SCENERY—TERMINUS AT SPENCER STREET, MELBOURNE.



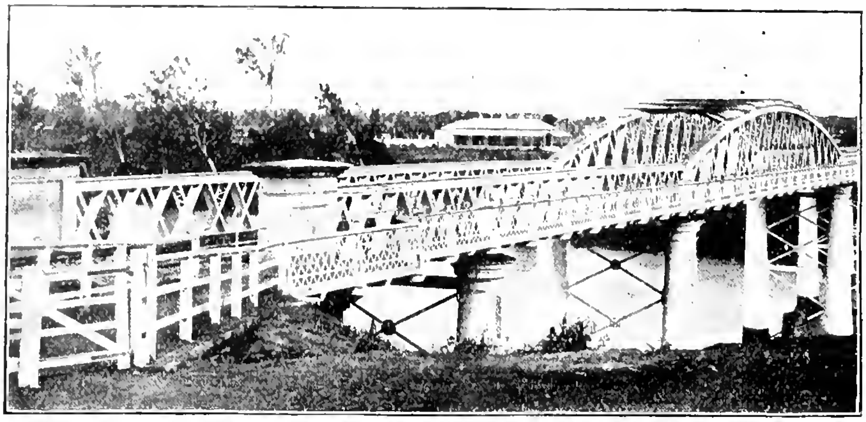
AUSTRALIAN RAILROAD SCENERY—ZIG-ZAG RAILWAY, BLUE MOUNTAINS, NEW SOUTH WALES.

noticed ever since the first heating of water and boiling of food for domestic purposes. The daily occurrence implied by the expression 'the pot boils over' was as common in antediluvian days as in modern times; and hot water thus raised was one of the earliest observed facts connected with the expansion of vapor. From allusions in the most ancient writings, we may gather that the phenomena exhibited by steam were closely observed of old. Thus Job, in describing leviathan, alludes to the puffs or volumes that issue from under the cover of boiling vessels. 'By his neesings a light doth shine,' and 'Out of his nostrils goeth smoke as out of a boiling pot or cauldron.'"

In the early use of the vessels last named, and before experience had rendered the management of them easy and safe, females would naturally endeavor to prevent the savory contents of their pots from flying off in vapor—hence, attempts were made to confine it by covers; and when these were not sufficiently tight, a cloth or other substance was interposed, and a stone or weight placed on top of the lid to keep it tight. The pressure would increase, and more weights were added to hold in the vapor. This contest, when carried on by a determined housewife on one side and a hot fire on the other, led to domestic boiler explosions.

For many centuries people tried to cork up the steam from the domestic broth pot,

and accidents frequently resulted, but the real cause was not popularly understood. There came to be a belief that there was a wicked spirit in a boiling kettle, and that in some cases the spirit was so violent in its disposition that it would smash things



Australian Railroad Scenery—Bridge Over Brisbane River, Queensland.

The Greatest American Work in Kangaroo Land—Built by Union Bridge Co., New York.

up and do great damage. It was only in comparatively modern times that common people learned that the steam from boiling water was a harmless gas when permitted to escape freely. This diffusion of knowledge relieved many a household from an oppressive dread. Think of nervous housewives in every part of the world where food was cooked, watching over the pot boiling the family dinner, and thinking a malignant spirit surging through the broth, threatening at any moment to burst forth and scald or slay the household! Shakespeare used the prevalent dread of the boiling pot to produce an awe-inspiring picture when, in "Macbeth," he made witches dance round a boiling pot, singing:

"For a charm of powerful trouble,
Like a hell broth, boil and bubble;
Double, double toil and trouble,
Fire burn and cauldron bubble."

In the railroad shops where a compressed air equipment is provided they are using compressed air very successfully for the testing of stay-bolts in the boilers of locomotives. The water is run out of the boiler, and then air pressure is applied. Any person can then distinguish the sound of a broken stay-bolt by the hammer test, for the pressure forces the ends of the broken bolt apart. When water is in the boiler the sound is not nearly so distinct as when it is empty. For this reason, testing under steam pressure is not nearly so efficient as testing under air, unless the water is blown out and the steam pressure retained. This can be done very readily, but the blowing out of the water is not a good practice where feed-water impurities are present.

Australian Railroad Scenery—Hawthorn Railway Bridge.

A brakeman, named William L. Mansberger, who was in the employ of the Terre Haute & Indianapolis Railroad, was injured by the breaking of a faulty coupling pin, and sued the road for $10,000 damages. The District Court of Illinois gave judgment in favor of the plaintiff, but it was appealed to the U. S. Circuit Court of Appeals by the railroad company, the contention being that the pin was on a foreign car, and, therefore, the road sued was not responsible. The Court of Appeals sustained the ruling of the court below, and held that the inspector of the road ought to have known that the pin which caused the accident was faulty. From this decision, it will be understood that a railroad company has no excuse for accidents happening to its employés through defects of foreign cars. They are as much responsible for the safe condition of foreign cars as they are of their own.

Since our last issue there has commenced a boom in the iron and steel business and several other lines of manufacturing. The wages of 250,000 workingmen have been advanced ten per cent., and it looks as if the hard times were on the wane. Railroads and railroad men will feel the effects later, but look out for a good business this fall and winter—it comes none too soon.

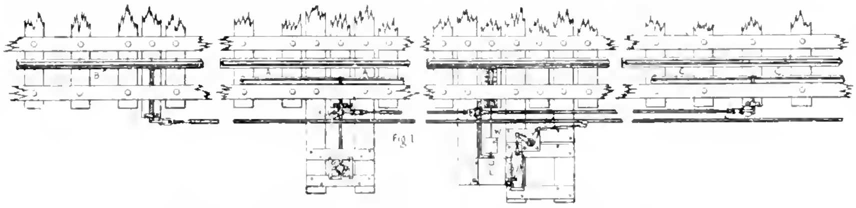
BLOCK SIGNALING

Construction—The Automatic Mechanical and the Staff Systems.

[SEVENTH PAPER.]

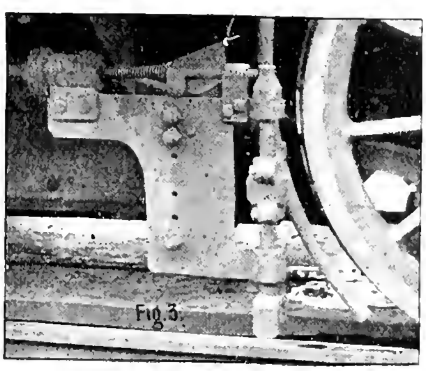
By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

With the automatic mechanical systems an attempt is made by mechanical means to automatically put the signa' at the entrance of the block at danger, when a train passes it, and to change the signal back to safety when the train passes out of the block. The necessary impulse, or power, to work the signal is obtained from the wheels of the train, an inclined bar placed against the side of the rail being pressed down by the first wheel passing over it, and the small movement thus obtained, being increased by an arrangement of levers, is made to work the apparatus. One of these bars, or trips, as they are called, is placed at the entrance of the block to set the signal at danger, and a second trip, placed at the end of the block and connected with the first trip and the signal by a pipe line, is used to change the apparatus and the signal back to the normal position when a train passes over it.



ROWELL-POTTER SAFETY STOP AND SIGNAL SYSTEM.

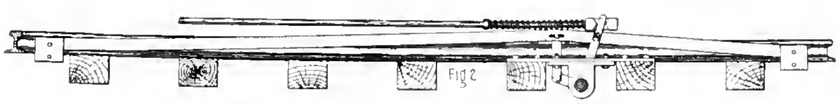
Two of these systems have come into a limited amount of use—the Rowell-Potter, on the "Alley" Elevated in Chicago, and the Boston, Revere Beach & Lynn in Massachussetts; and the Black system, on the Metropolitan Elevated roads in New York City. The Rowell-Potter system was applied to the Intramural Railway at the World's Fair, but was not a strictly mechanical plant, the release, or restoring of the signal to the normal position, being effected by means of electricity. As applied to the "Alley L," the equipment is nothing more than a station protector, the track for 1,000 feet in front of each station being made into a block, the signal being placed 650 feet from the station. If the blocks were multiplied sufficiently, the entire road would be protected, and trains could then follow each other no closer than the length of a block; as it is now, several trains may be run between two stations, but no train can pass the signal and not be stopped, so long as a train is in the station block. The Rowell-Potter system makes a notable departure from the ordinary signal systems, in that provision is made for stopping a train independently of the engineer, should he be negligent, or, from physical causes, be unable to obey the signal. The system is not only automatic, but obedience to the signal is made compulsory, and all chance of a mistake being made is eliminated.



THE AIR VALVE.

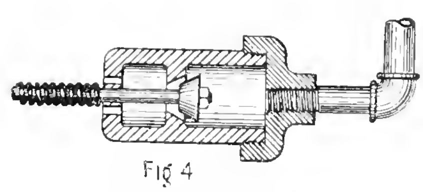
The principal parts of the system are: the inclined bars or trips, the safety stop and air valve for applying the air if a danger signal is disregarded, and a latching device for holding up a weight and allowing the signal to be kept at danger as long as a train is in the block.

The inclined bar, or trip, is shown in Fig. 2, and also at *E* in Fig. 1. One bar is about 6 feet long, the other 4 feet, the point where they are connected being raised 1 inch above the top of the rail. A train passing over the bars will gradually press them down, owing to their being inclined, and the motion so imparted is transmitted by a connecting rod and crank to a pipe line to work the signal or other parts of the apparatus.



INCLINED BARS OR STRIPS.

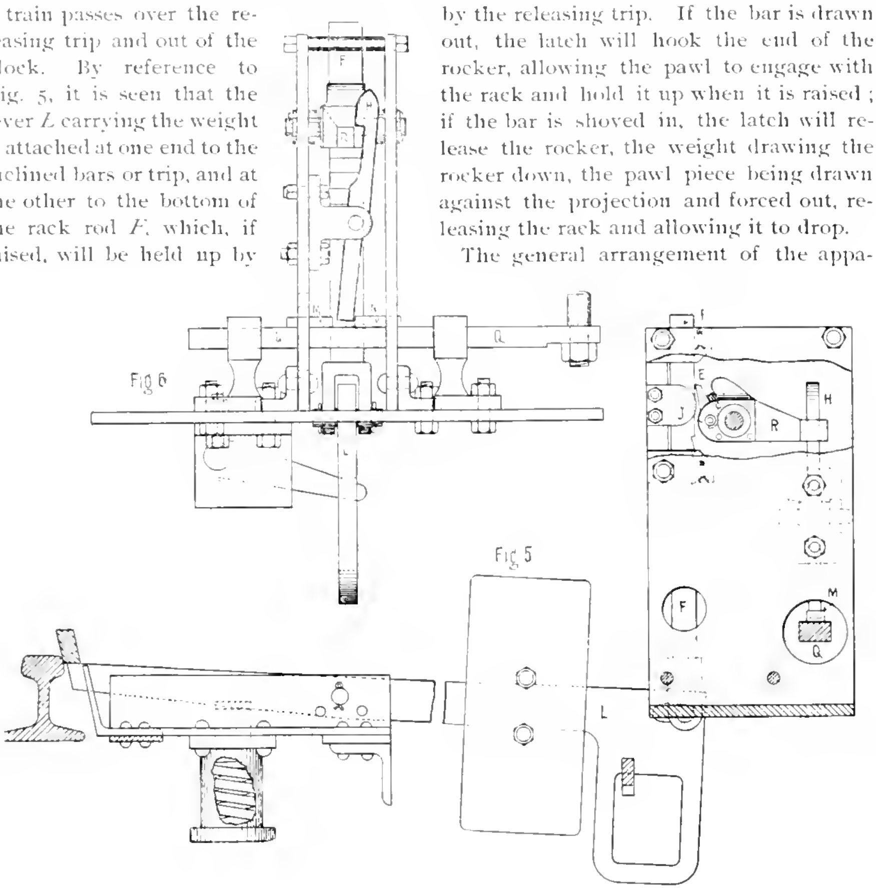
The safety stops for applying the air are shown at *A* and *C*, Fig. 1, being placed at such a distance out from the rail that they will, if raised, strike the roller of the air valve on the engine, opening it and applying the air. Practically, the construction is the same as that of a trip, except that the bars are lighter and are raised at the joint by a crank worked from the pipe line. The air valve is shown in Fig. 3, a cross section of the valve, when open, being shown in Fig. 4. Ordinarily the valve remains closed; but should an engineer attempt to run by a signal, or should a part of the apparatus get out of order, the safety stop bars (*A* or *C*, Fig. 1) being raised, would strike the roller placed at the bottom of the vertical shaft, pressing it up, which, by means of the cam on the top of the shaft, presses in the valve rod, opening the valve and applying the air, the valve being held open by the latch dropping down in the slot cut in the rod. The wire fastened to the latch extends up through the running board, so that the engineer can, by pulling up the latch, allow the valve to close and release the brakes before the train has been brought to a full stop. A right and left screw on the shaft allows for adjustments to be made to keep the roller standard height above the top of the rail.



AIR VALVE OPEN.

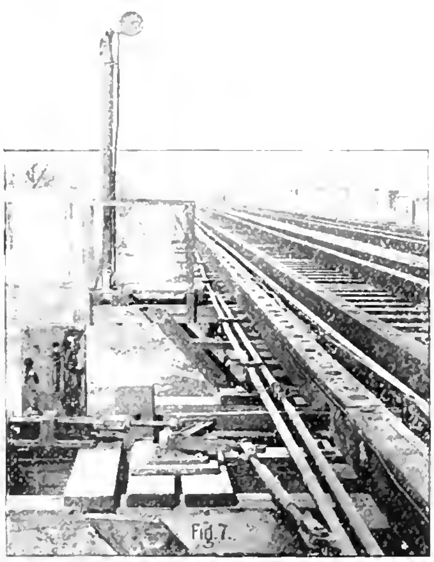
The latching device is shown at *L*, Fig. 1, and in detail in Figs. 5 and 6. The object of this device is to hold up the weight (seen at *W*, Fig. 1) after it has been raised by a passing train, allowing the counterweights *N* and *V*, Fig. 1, to carry

the signal to danger and to drop the weight, thereby raising the two weights N and V, clearing the signal, and restoring the apparatus to its normal position when a train passes over the releasing trip and out of the block. By reference to Fig. 5, it is seen that the lever L carrying the weight is attached at one end to the inclined bars or trip, and at the other to the bottom of the rack rod F, which, if raised, will be held up by



LATCHING DEVICE.

the pawl piece E, engaging with the teeth cut in the rod F if the rocker R is held by the latch H. If the rocker R is not held by the latch H, the rack will pull the



ROWELL-POTTER AUTOMATIC MECHANICAL SIGNAL AT "SAFETY."

rocker down, bringing the pawl E against the projection J, forcing the pawl piece out and allowing the rack rod F to drop.

The latch H is worked by the two lugs M and N on the releasing bar Q, the releasing bar being operated by a motion plate connected by means of a crank and connecting rod to the pipe line operated by the releasing trip. If the bar is drawn out, the latch will hook the end of the rocker, allowing the pawl to engage with the rack and hold it up when it is raised; if the bar is shoved in, the latch will release the rocker, the weight drawing the rocker down, the pawl piece being drawn against the projection and forced out, releasing the rack and allowing it to drop.

The general arrangement of the apparatus is shown in Fig. 1, B being the operating trip placed in front of the signal, where a train will pass over it and, by pressing it down, raise the releasing trip, and also hook the latch of the latching device over the rocker, setting the instrument to hold the weight up when it is raised. Next to the operating trip, and opposite the signal, is the primary safety stop, which, if the signal is in the clear position, will be depressed, and will allow a train to proceed without stopping it. Next to this the signal trip and latching device is located, a secondary safety stop being placed beyond the primary stop.

The two safety stops are connected by a pipe line worked by counterweights, as shown, so that when one is depressed the other is raised, a crank worked by the lever of the signal trip being used to connect the pipe line with the weight and clear the signal when the weight is dropped.

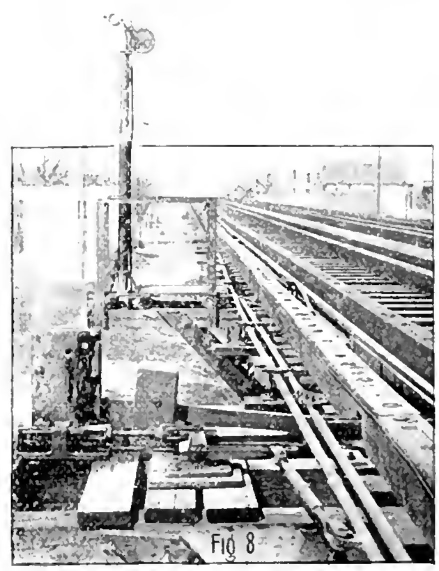
At the end of the blocked section a trip, called the releasing trip, is placed, to restore the signal to the clear position when a train passes out of the block. It is connected to the operating trip by a pipe line, and so arranged that when the operating trip is down, the releasing trip will be raised. When the releasing trip is pressed down it will raise the operating trip, and thus leave the apparatus ready to be worked by the next train.

The operation of the system is as follows, supposing the apparatus to be in the normal position, with the operating trip raised, the primary safety stop depressed, and the signal at safety, as is shown in Fig. 7, and that a train is approaching:

When the engine passes over it the operating trip will be depressed, raising the releasing trip and drawing out the releasing bar, latching the rocker of the latching device, so that the weight when raised will be held up. The signal being in the safety position and the primary stop depressed, the engine passes by without the air valve being opened; when the engine reaches the signal trip the bars are depressed, raising the weight which now is held up by the latching device, the crank operating the pipe line to the signal being turned by the lever, changing the signal to danger, raising the bars of the primary stop (as is shown in Fig. 8), and depressing those of the secondary stop, so that the engine passes on into the block without having the air applied.

When the engine has moved beyond the station a distance of 330 feet, it passes over the releasing trip and depresses it, the operating trip in consequence being raised and the releasing bar of the latching device pulled out. This allows the weight to fall and restore the signal to the safety position, the secondary safety stop being raised and the bars of the primary safety stop depressed, the apparatus thus being left in the normal position, to allow a second train to enter the block.

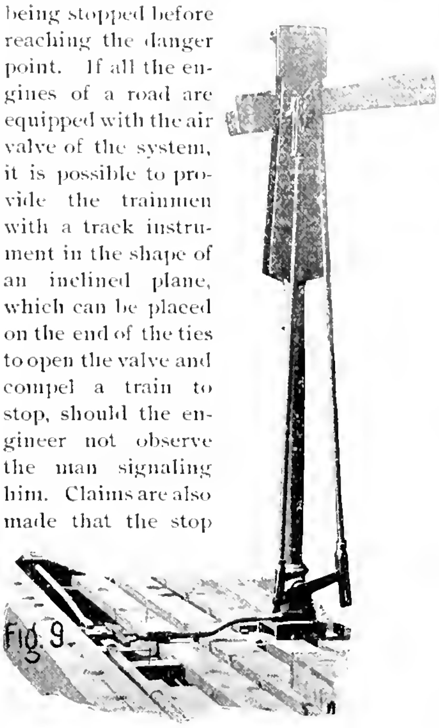
By connecting the two safety stops with the signal trip in the manner shown, it insures that the brakes would be applied and the train stopped should the signal not be thrown to danger after the passage of a train. It will also enable the engineer



ROWELL-POTTER AUTOMATIC MECHANICAL SIGNAL AT "DANGER."

to tell whether he has been stopped by a train in the block, or by some defect of the apparatus, due to breakage or to lack of adjustment. Switches are easily protected

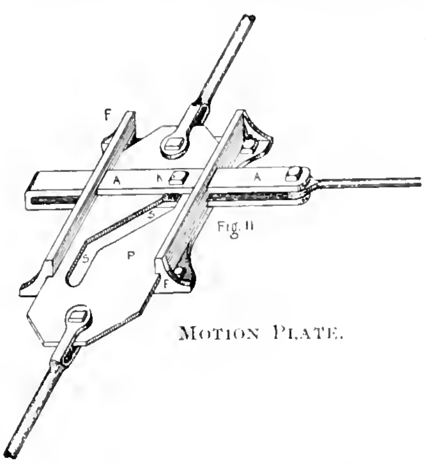
with this system, by providing a signal and safety stop to be worked from the points of the switch, at such a distance from the switch as will admit of the trains being stopped before reaching the danger point. If all the engines of a road are equipped with the air valve of the system, it is possible to provide the trainmen with a track instrument in the shape of an inclined plane, which can be placed on the end of the ties to open the valve and compel a train to stop, should the engineer not observe the man signaling him. Claims are also made that the stop



Black's Automatic Mechanical Signal at "Danger."

is an excellent device to be used in connection with any manual system, as it compels obedience on the part of the engineer to the indication of the signal.

As installed on the "Alley L," the system has given good satisfaction. While it has been found necessary to strengthen some of the parts, the wear on the apparatus, as a whole, has been very small. While applications, due to a failure of the apparatus, occasionally happen, there has also been a few failures to apply the brakes, where they should have been applied. This has occurred through water collecting in the valves, or on the outside,



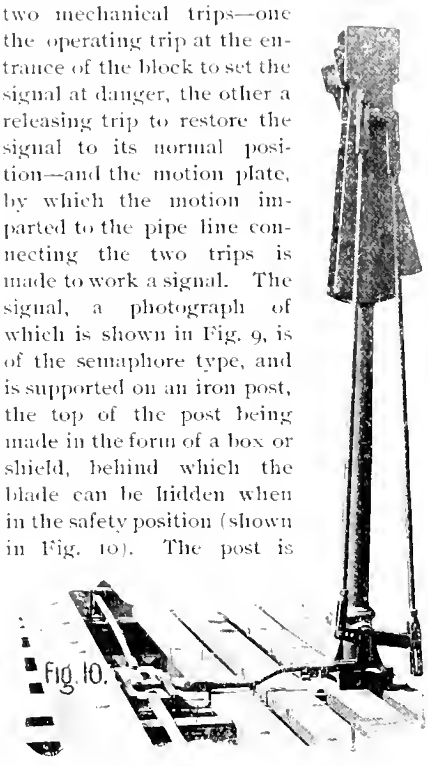
Motion Plate.

and freezing up the vent holes, preventing the air from escaping when the valve was opened.

Should the roller become knocked off, as might easily happen on a surface road, or the inclined bars of the safety stop get broken, no application of the brakes would be made, in which case, should the engineer be depending on the application of the brakes to indicate danger, the consequences might be serious.

Black's automatic mechanical system is in use on portions of the elevated roads of New York City, and is a much simpler system than the Rowell-Potter. It is a signal system only, no attempt being made by mechanical means, or otherwise, to compel an engineer to obey the signal if it is at danger.

The principal parts of the system are the two mechanical trips—one the operating trip at the entrance of the block to set the signal at danger, the other a releasing trip to restore the signal to its normal position—and the motion plate, by which the motion imparted to the pipe line connecting the two trips is made to work a signal. The signal, a photograph of which is shown in Fig. 9, is of the semaphore type, and is supported on an iron post, the top of the post being made in the form of a box or shield, behind which the blade can be hidden when in the safety position (shown in Fig. 10). The post is



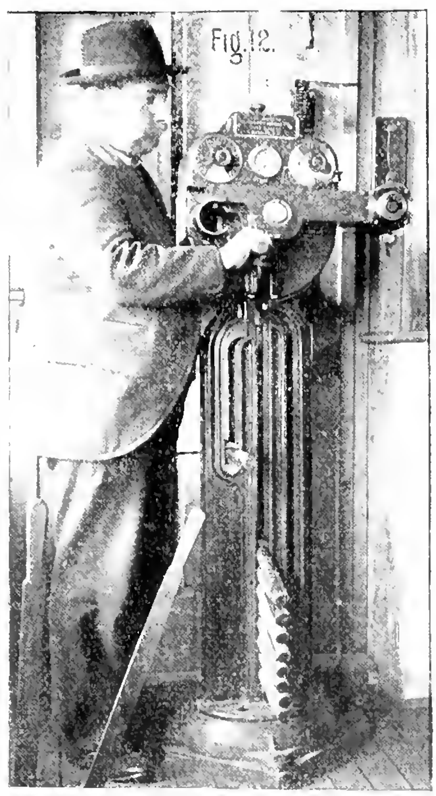
Black's Automatic Mechanical Signal at "Safety."

painted black, so that the safety indication is given by the absence of the signal, rather than by its vertical position.

It will be noticed that three of the jaws on the two up and down rods connecting the "T" crank at the base with the signal, are slotted; this is done to relieve the signal casting of the sudden blows transmitted by the two trips, and allow the signal to be moved to the safety position by the force of gravity. The trips are of the same pattern as those used with the Rowell-Potter system, the wheels of the engine pressing down the inclined bars placed at the side of the rail, thereby turning a shaft connected to the pipe line by a crank, and moving it, the motion being imparted through the medium of a spiral spring. The motion plate, by which the motion imparted to the pipe line is transmitted to the "T" crank of the signal, is shown in Fig. 11. The plate *P* sliding in the frame *F*, forces the bar *A* to move from one side to the other, by means of the pin *K* working in the slot *S*, the bar *A* being connected by a rod with the "T" crank at the base of the signal pole. The slot is made somewhat longer than the travel of the pipe line, to allow for changes in the length of the connections, from expansion and contraction, without affecting the movement of the signal.

As installed on the New York Elevated, the blocks are of about 1,700 feet in length, the operating trip being placed a short distance beyond the signal, so that the signal will not go to danger until the locomotive has passed it. The releasing section is carried past the next signal into the next block ahead, thus providing an overlapping section, and insuring that there will always be a signal at danger behind a train. On this road, the blocks are made continuous—that is, the entire track is equipped with the device, and not at stations only, as is the case with the Rowell-Potter system on the "Alley L" road in Chicago.

While the automatic mechanical systems have undoubtedly been giving satisfaction in the applications that have been made, the argument cannot be made from these installations that such systems would be

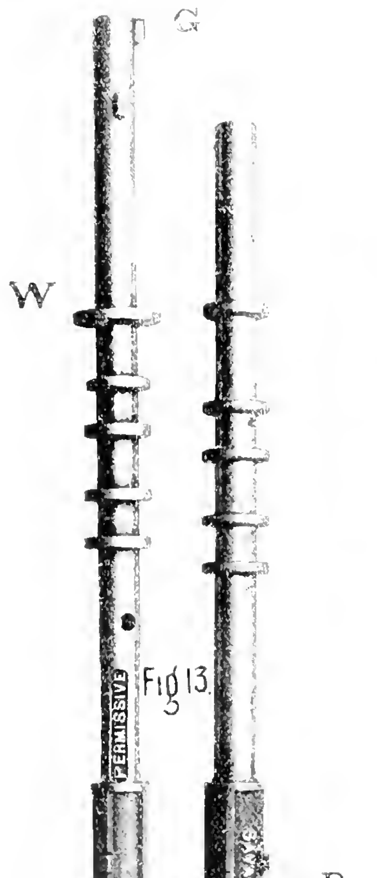


Withdrawing Staff from Webb & Thompson Staff Instrument.

applicable with any degree of success or durability to the ordinary surface roads of this country. In the equipments spoken of, the length of the blocks is between 1,000 and 1,700 feet, and, judging from the strains put upon the apparatus, this is very nearly the limit at which it is possible to operate the mechanism successfully. This length of block, with the long trains

that are being run to-day, would furnish no protection, as the signal would be cleared about the time that the rear car passed it. Unless the blocks can be made a mile long, it would be useless to make an application, even if the matter of expense was left out.

Again, since the inclined bars are pressed down by the wheels of the train, it follows that the speed at which the train runs will materially affect the blow given the apparatus; and while, with the present equipment, there has been very little trouble from this cause, the speed has been about 40 miles an hour only, so that one cannot say positively what the effect would be at higher speeds. Any equipment to a surface road would be very hard to maintain during the winter, owing to snow and ice clogging up the parts, which, unless they worked freely, would apply the air and stop trains when they should not be stopped. While the objection to the length of the block would be overcome by using an electrical release with the Rowell-

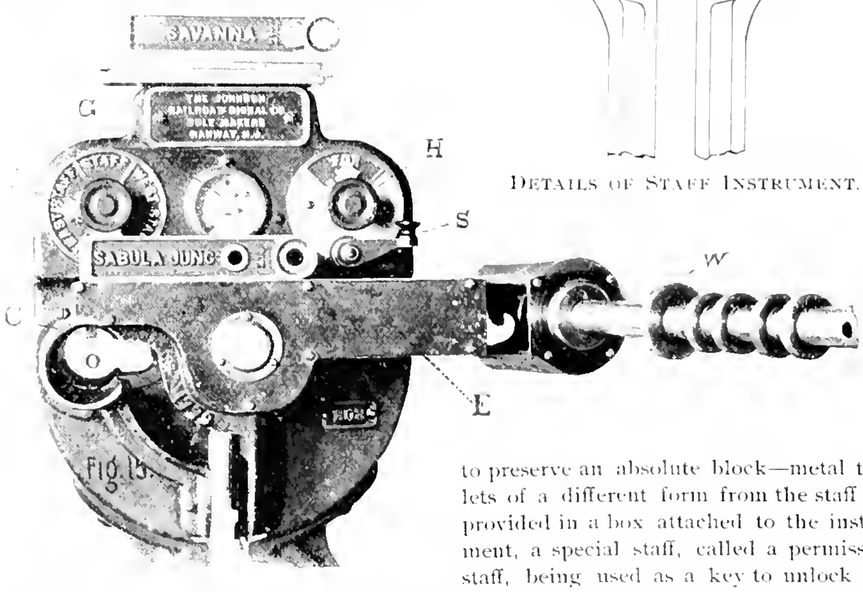


THE STAFF.

Potter system, it is very probable that such an instrument would require too careful adjustment and have to be of too light a construction to be a practical success. Such an arrangement was used with the equipment on the Intramural at the World's Fair, and gave very good results, but as a new design has been gotten out by the signal company, it is evident they do not think the arrangement then used would work successfully on a surface road.

Regarding the applications of the systems that have been made to the elevated roads, criticisms have been made that it is impossible to run the trains on schedule time if the signals are obeyed, and that, in consequence, they are, on the New York Elevated, disconnected the greater part of the time, or the engineers are allowed to run by them when at danger. Any such criticism applies solely to the length of the block, or the distance apart which the signals are placed, and not to defects of the apparatus; for if the signals are further apart than it is desired to run trains, traffic will, of course, be delayed whenever the signals have to be obeyed.

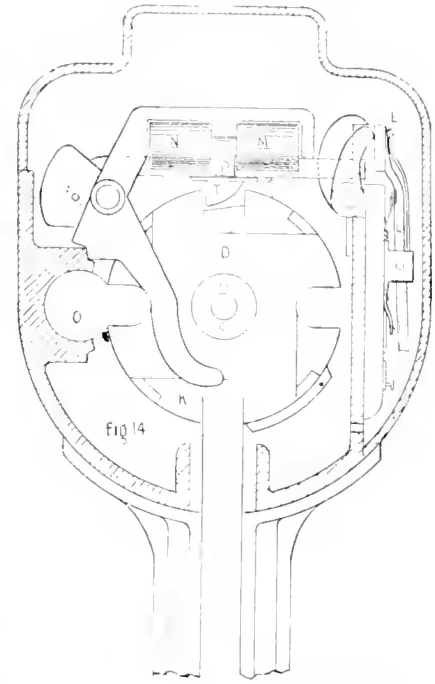
Having now explained the construction of the principal block signal systems in use in this country, it would be well to more particularly describe the new Electric Train Staff system, which was spoken of in the second article as having been installed and in successful operation on the Chicago, Milwaukee & St. Paul Railway. The instrument used is one invented by Messrs. Webb & Thompson, and has been adopted by the London & Northwestern



Railway Co., of England, as their standard apparatus for blocking trains on single-track lines.

The essential feature of this system is that a staff, either of metal or wood, is carried by the engineer as his authority to run his train over a given piece of track, the several staffs provided with this system being locked mechanically in the station instruments, so that but one staff can be removed at the same time from either instrument. Two instruments are provided, one being placed at each end of the block or section of track to be controlled by the staffs. A wire connection is made between the two instruments for electrically unlocking the machines and allowing a staff to be withdrawn. Withdrawing a staff from either instrument locks up both instruments of that section, so that no staff can be taken out until the staff withdrawn is replaced in one or the other instrument. A staff may be withdrawn from either instrument and a train started from either end of the block at any time, provided a staff has not been withdrawn and given to some other train that is in the block.

To allow trains to be run in the block permissively—for it is not always desirable



DETAILS OF STAFF INSTRUMENT.

to preserve an absolute block—metal tablets of a different form from the staff are provided in a box attached to the instrument, a special staff, called a permissive staff, being used as a key to unlock the box. Each one of the six tablets which are provided, may be used to forward a train, the last train taking the permissive staff and any remaining tablets.

From this it is seen that when an engineer has a staff with him on his engine, he knows that the block ahead of him is clear, and that no train running in an opposite direction can enter the block. When he has a tablet with him, instead of the usual staff, he knows that there may be other trains in the block running in the same direction that he is, but that there can be no train running in the opposite direction.

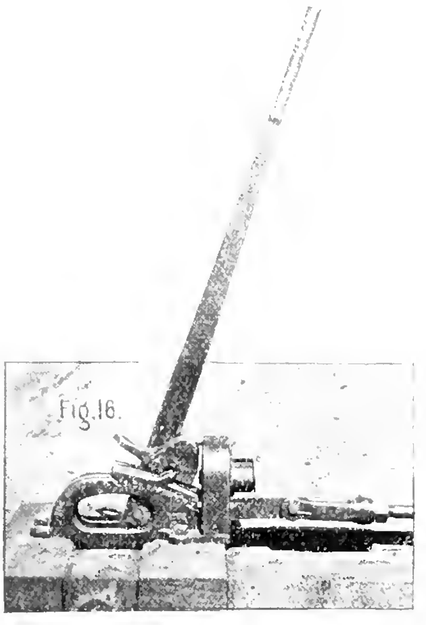
A general view of the staff instrument is shown in Fig. 12, an ordinary and a permissive staff being shown in Fig. 13. The principle upon which the machine is constructed is, that when a staff is withdrawn, the electric current energizing one of the

magnets, which lifts the lock, allowing a staff to be withdrawn, is reversed through the coils of the magnet, neutralizing the effect of the current on the magnet, and making it impossible to again take out a staff until the currents have been restored to their proper polarity by placing the staff back in one of the instruments.

Details of the instrument are shown in Fig. 14, *M* being the magnet connected by the line wire with the battery of the other instrument through the key *S* (Fig. 15), *N* the magnet energized by a local battery, the circuit being closed by turning the indicator handle *H* (Fig. 15). *T* is the armature of the magnets *M* and *N*, and is of such shape as to fit in the slot in the drum *D* and prevent it from turning, unless the armature is lifted by the magnets when they are raised. The arm carrying the magnet is provided with a tail-piece, which is lifted by a projection on the staff whenever an attempt is made to remove a staff. If the magnets are energized by a current of the proper polarity, the armature is held up when the magnet is raised, and the drum *D* is allowed to turn, the staff being drawn through the segmental slot *K* to the opening *O*, where it can be withdrawn from the instrument. The levers *L*, placed on the side of the instrument, are made to reverse the electric currents flowing through the magnet *N*, by changing the contacts from one end to the other whenever a staff is withdrawn from the instrument, and thus, not only prevent a second staff being withdrawn, but to reverse the current sent out to the other instrument when the key *S* is pressed, and make it impossible for a staff to be taken out of the other instrument also.

To explain more fully the effect of reversing the current through one of the magnets, it must be noticed that the poles of the two magnets are joined together, forming a single pole piece *P*. If the iron of the two magnets is magnetized, so that the north pole of one will be opposite the south pole of the other, there will be a mutual attraction, and each will satisfy the magnetic attraction of the other. If, however, the poles of the two magnets are of the same polarity, it will have the effect of making the two magnets act as one magnet, the iron projection *P* between the two coils now becoming the pole piece, and the armature, in consequence, will be attracted. From this it is seen that there must be two circuits to work the magnets of each machine—one from the main line battery of one instrument, closed by pressing on the key *S*; the other an entirely local circuit, closed by turning the indicator handle *H* of the other instrument.

A galvanometer *G* (Fig. 15), placed in circuit with the main line wire, serves to inform the operator, when he wishes to withdraw a staff, when the operator at the other instrument has pressed down the key *S* and closed the main line circuit. The indicator *J*, placed on the left side of the instrument, is used to designate from which instrument a staff has been withdrawn, and also, when turned clear around, to break the main line circuit, allowing the galvanometer needle to return to a vertical position, and thus notify the



A Staff Lock.

other operator that the staff has been removed and he can release the key. A single-stroke bell, placed in the main line circuit, rings each time that the key of the instrument at the other station is pressed.

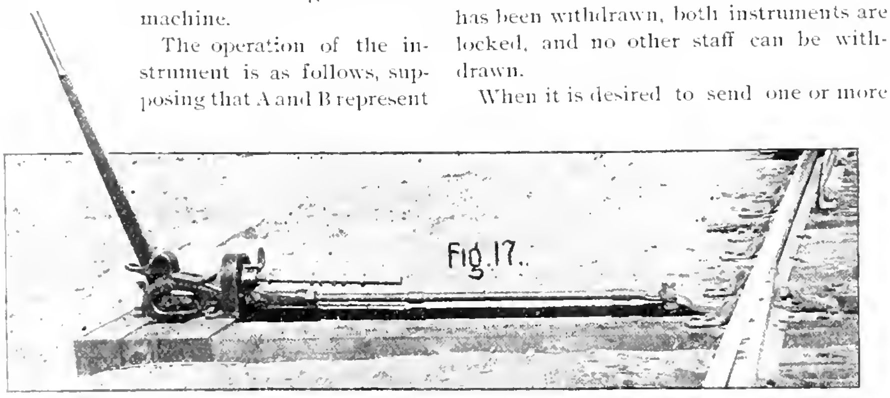
The staffs (shown in Fig. 13) are made of a piece of iron pipe, name plates of the two stations at the ends of the block being riveted on the end. The rings riveted to the staff serve as projections to fit in between the wings of the drum *D* (Fig. 14), to raise the several latches, as well as to make it impossible to place a staff taken from the instrument of one block into the instrument belonging to the next block. The number of staffs provided for each instrument is usually ten, but as many may be used as will go into one machine.

The operation of the instrument is as follows, supposing that A and B represent the stations at the ends of the block, and that a train is ready to start from A to B: A asks, by taps of the bell, according to an arranged code of signals, for permission to withdraw a staff. B responds, if there is no train in the block, by pressing on the key *S* (Fig. 15), sending a current through the magnet *M* and the galvanometer, the needle of which is immediately deflected. A turns the indicator handle *H* to "For Staff," thereby closing the local circuit, and lifts the staff to the top of the slot, as shown in Fig. 12. The projection on the staff strikes the tail-piece, as before described, lifting the magnets, which, as the pole piece is now energized, also lifts the armature and unlocks the drum, allowing the staff to be withdrawn from the instrument. Immediately the staff is withdrawn, the operator turns the indicator *J* (Fig. 15) to "East" or "West Staff Out," as the case may be, breaking the main line circuit, and allowing the galvanometer needle to assume the vertical position and inform the operator at B that a staff has been withdrawn. Withdrawing the staff automatically causes the indicator *H* to return to the position "For Bell," breaking the local circuit and preventing the battery from being run down.

The staff is then given to the conductor, who gives it to the engineer, to be kept on the engine. On the arrival of the train at B, the staff is taken to the office and given to the operator, who places it in his staff instrument, and notifies A, by taps on the bell, that the staff has been placed in the instrument. Another staff can then be withdrawn from either instrument, and a train sent in either direction through the block that is desired.

To block trains permissively, six tablets are provided, a projection or lug being provided on the end of the permissive staff (shown at *G*, Fig. 13), by which the box *E* (Fig. 15), on the face of the instrument, in which the tablets are placed, may be unlocked and the tablets removed, as shown. As soon as any of the tablets are removed from the box, a catch-piece *C* is dropped into the opening *O*, so that the large ring *W* on the permissive staff will not admit of the staff being put back in the instrument, and as the permissive staff has been withdrawn, both instruments are locked, and no other staff can be withdrawn.

When it is desired to send one or more trains into the block, the permissive staff is withdrawn from the instrument the same as any other staff, and is used to unlock the box containing the six tablets. A tablet is given to each train that it is desired



Switch Unlocked and Thrown.

to send forward, the last train being given the staff and any remaining tablets; for, unless all the tablets have been placed in the tablet box of one instrument or the other, it is impossible to put the permissive staff in either instrument, and, until this is done, the section would be blocked, as no other staff can be withdrawn.

A staff lock, shown in Fig. 16, is provided at all switches in the block. Projections on the staff, seen at *P*, Fig. 13, serve as a key to unlock the switch. To unlock the switch, the end of the staff is placed in the lock and turned, when, if the catch is pressed down, the switch may be thrown by pulling over the lever, as seen in Fig. 17. When the staff is turned in the lock and the switch opened, it is impossible to withdraw the staff, so that a trainman not only has to leave the switch set for the main line, but is compelled to lock it before removing the staff. As no switches can be opened without the staff, and there can be but one staff taken out of the two instruments at the same time, an engineer knows when he has the staff that all the switches in the block are set for the main line and that they are locked.

There have been several staff instruments of different patterns perfected and put in use in England, but the one shown here is very simple and durable, and not likely to get out of order. The battery power required is large, but this is due more to the high resistance to which the magnets are wound than to the particular design of the machine.

The system is in use on the C., M. & St. P. Railway, between the stations, Savanna, in Illinois, and Sabula Junction, in Iowa—a section of track that is not only very crooked, but in which there is a very long bridge over the Mississippi River, making it highly important that every precaution be taken against accidents, not only from rear end collisions, but from dispatchers and others making mistakes, and allowing two trains, traveling in opposite directions, to try and use that piece of track at the same time.

The system has given the greatest satisfaction since it has been installed, not only in regard to the safety with which the traffic can be handled, but the facility with which trains can be dispatched. To quote the words of Mr. C. A. Goodnow, superintendent of the C., M. & St. P. Railway, in a paper read before the Western Railway Club:

"I cite these few examples of the many complications that must necessarily arise in the handling of traffic on single track, to illustrate the facility with which the staff system does its train dispatching; its possibilities in connection with the movement of trains on single track, and its especial adaptability to short stretches of track, used by the trains of several divisions or different railways, as compared with the telegraphic movement; the advantage, both as regards safety and facility of handling, being distinctly with the staff system.

"It is not my intention to decry our system of train dispatching. There can be no question but what it is a most economical and satisfactory method of handling heavy traffic, under ordinary conditions, with not too heavy a train movement; but we are obliged to admit that the system is open to objections which particularly relate to safety as well as facility. The staff system is capable of extended application. It is at once a block signal, a train dispatcher, and a time-table. It is to the movement of trains between stations what the interlocking of switches and signals is at stations and grade crossings."

With the staff instruments in use, the cumbersome method of dispatching trains by orders can be done away with. The dispatcher need keep only his train sheet, informing each operator to which train a staff is to be delivered. There need be no safeguards taken to prevent either he or the operator from making mistakes, as the machines are an absolute check against all such. The time necessary to transmit orders is only that required to send a short message. Orders can be annulled and changed with equal facility, as there is no necessity for doing more than to order the operator not to give a staff to a certain train. Should he disobey orders there would be no accident, and nothing more serious would happen than a delay to the train that the dispatcher wanted to have go forward.

If all the stations of a division were equipped with staff instruments, some means would have to be devised by which a staff could be taken on the engine at speed, as slowing up at all stations would not only be expensive, but would make it impossible to run fast trains.

At present the staffs are taken on at speed by an attachment provided on the tender, similar to the hook on a mail car, but as the arrangement will not work successfully at speeds much above 30 miles, a change of some sort would have to be made before it could be considered suitable for general use.

How Easy It Is to Get Up a New Brake.

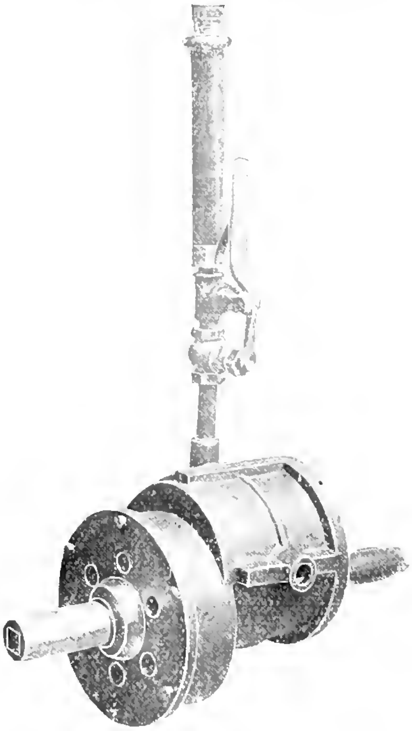
Every few days some bright mind stumbles onto an idea about brakes, and writes to us, to Westinghouse, or to some railroad man of standing, for an opinion of the value of the idea. The following is a fair sample of such a communication, sent to a prominent railroad official:

"Dear Sir—In thinking about an entirely different matter, an idea has occurred to me by which an automatic brake for a freight car can be constructed that will not interfere with the forward movement of the car in either direction; but, when the car is started on a journey, either end foremost can be so adjusted that a backward movement of, say, as much as two car lengths, or less, will put on a dead lock and stop the car. It has occurred to me that this would be of practical use in preventing accidents by trains breaking in two on grades. Your kind and courteous replies to me on all matters in the past, have led me to ask if such an appliance would be of any practical value."

A Pneumatic Stay-Bolt Driller.

The accompanying illustration shows the exterior of a device gotten up by Master Mechanic George Smith, of the A., T. & S. F., at Topeka, Kan.

It is in the form of a small rotary engine, the shaft of which carries a pinion meshing into a larger gear on the drill shaft.



For drilling stay-bolts, and for tapping out stay-bolt holes in boiler, as well as screwing in the bolts, it is a very fast-working tool. We have seen it at work making one hundred and twenty turns per minute. One would naturally think that this speed would strip the threads out of the hole or break the tap—but it don't.

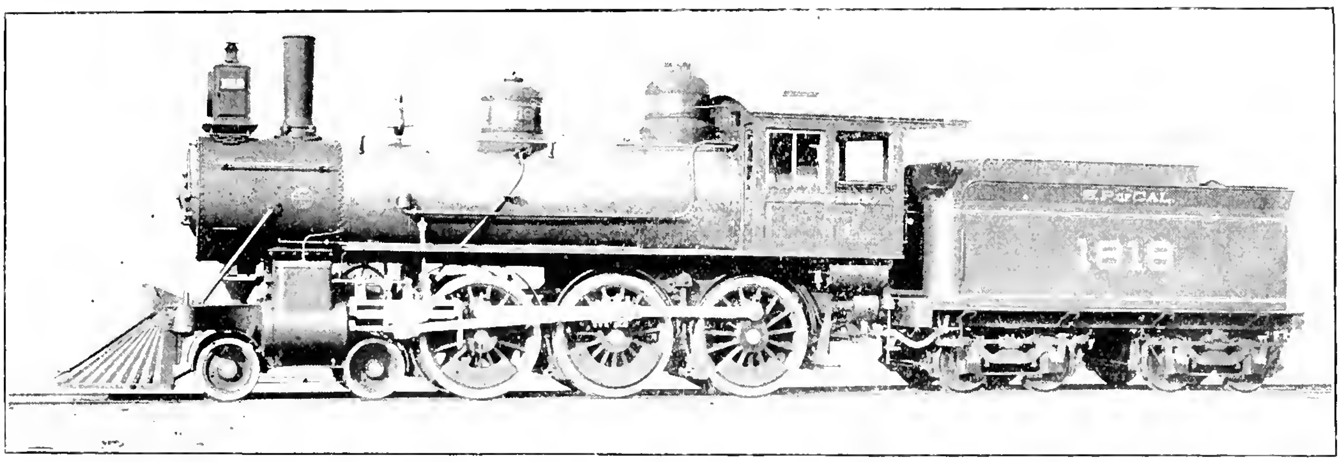
The cylinder of this engine is round, as shown, having a steam inlet on one side and an exhaust outlet on the other. A shaft runs through the cylinder lengthwise, said shaft being considerably out of the center; this shaft is enlarged in the cylinder and one side of it runs a close fit to that part of the cylinder between the steam and exhaust openings.

The enlarged shaft has a slot through it lengthwise; in this slot fits a square slab carrying packing strips at the edges. This slab just fills the cylinder, and as the shaft revolves it, it moves back and forth in the slot, at every half revolution presenting a new piston for the entering air to move forward. There are two exhausts to each revolution; but they are so fast at ordinary speeds that it is a continual sound of escaping air. The whole work is controlled by the hand valve. This form of air engine is not the most economical of air, but its compact and handy form makes up for it.

Heavy Ten-Wheeler for the Southern Pacific.

The Cooke Locomotive and Machine Co., of Paterson, N. J., have recently built twenty extra heavy ten-wheeled locomotives for the Southern Pacific. These engines are intended to pull either freight or passenger trains on their mountain grades, and are remarkably good all-round engines. The principal dimensions are as follows:

Gage, 4 ft. 8½ in.
Height, top of stack from rail, 15 ft. 2⅝ in.
Height, center of boiler from rail, 8 ft. 2 9/16 in.
Weight of engine in working order, 140,000 lbs.
Weight on drivers in working order, 106,000 lbs.
Weight on truck in working order, 34,000 lbs.
Total wheel base of engine, 22 ft. 8 in.
Rigid wheel base of engine, 12 ft. 2 in.
Total wheel base of engine and tender, 47 ft. 9½ in.
Cylinders, simple.
Cylinders, diameter, 20 in.
Cylinders, stroke, 26 in.
Cylinders, length of ports, 18 in.
Crank pins, side-rod journal, front, 4½ in. diameter by 3⅞ in.
Crank pins, side-rod journal, back, 4½ in. diameter by 3⅞ in.
Boiler, wagon top; fuel, bituminous coal.
Boiler, working pressure, 180 lbs.
Boiler material, shell, Carnegie steel.
Boiler material, firebox, Shoenberger steel.
Boiler, thickness of plates, shell, 9/16 in.
Boiler, thickness of plates, side firebox, ⅜ in.
Boiler, thickness of plates, front firebox, ½ in.
Boiler, thickness of plates, crown firebox, ⅜ in.
Boiler, diameter of first course, outside, 60⅛ in.
Boiler, firebox, length, 96 in.
Boiler, firebox, width, 42 in.
Boiler, firebox, depth at back, 59 in.
Boiler, firebox, depth at front, 62 in.
Boiler, tubes, material, charcoal iron.
Boiler, tubes, number, 268.
Boiler tubes, diameter, length and thickness, 2 in., 12 ft. 5½ in., No. 12.
Boiler, crown bars, number, 20.
Boiler, crown bars, depth and thickness, 6 in. x ¾ in.
Boiler stay-bolts, 1 in. x ⅞ in.
Grate, rocking finger packing.



HEAVY TEN-WHEELER, FREIGHT AND PASSENGER, BUILT BY THE COOKE LOCOMOTIVE AND MACHINE CO., PATERSON, N. J.

Cylinders, width of steam ports, 1¾ in.
Cylinders, width of exhaust ports, 3 in.
Piston, solid.
Piston packing, 3 spring rings.
Piston rod, steel, 3½ in. diameter.
Piston-rod packing, Kilborn & Young's.
Slide valve, American-Allen.
Slide-valve lap, 1 in. outside.
Slide valve, full travel, 5¾ in.
Driving wheels, 6.
Driving wheels, diameter outside tires, 63 in.
Driving wheels, diameter of center, 56 in.
Driving wheels, tires, material, Latrobe steel.
Driving wheels, tires, size, 3½ x 5¾ and 3½ x 6¼.
Driving axles, hammered iron.
Driving axles, diameter, 7½ in.
Driving axles, length of journal, 8½ in.
Engine truck, center bearing.
Engine-truck wheels, 30-in. Krupp.
Engine-truck axles, hammered iron.
Engine-truck axles, diameter, 5½ in.
Engine-truck axles, length of journal, 8⅞ in.
Crank pins, steel.
Crank pins, main-rod journal, 5½ in. diameter by 5½ in.
Crank pins, side-rod journal, middle, 5¾ in. diameter by 5 in.
Ashpan, sectional, with dampers.
Smokestack, cast-iron, 14 in. diameter.
Exhaust pipe, single.
Injectors, 1 inch, Nos. 8 and 9 Monitors.
Brake, combined Westinghouse-American, schedule W. M.
Lubricator, Nathan triple.
Engine also equipped with water-brake and Sweeney-brake attachment to Westinghouse system.
Frame, iron.
Trucks, square wrought-iron frames.
Truck wheels, Canada, 33 in.
Truck axles, hammered iron.
Truck-axle journals, 4½ in. diameter by 8 in. long.
Tank, water capacity, 4,000 gals.
Tank, coal capacity, 12 tons.
Tender, weight loaded, 81,000 lbs.

The Railroad Accident Account of Last Year.

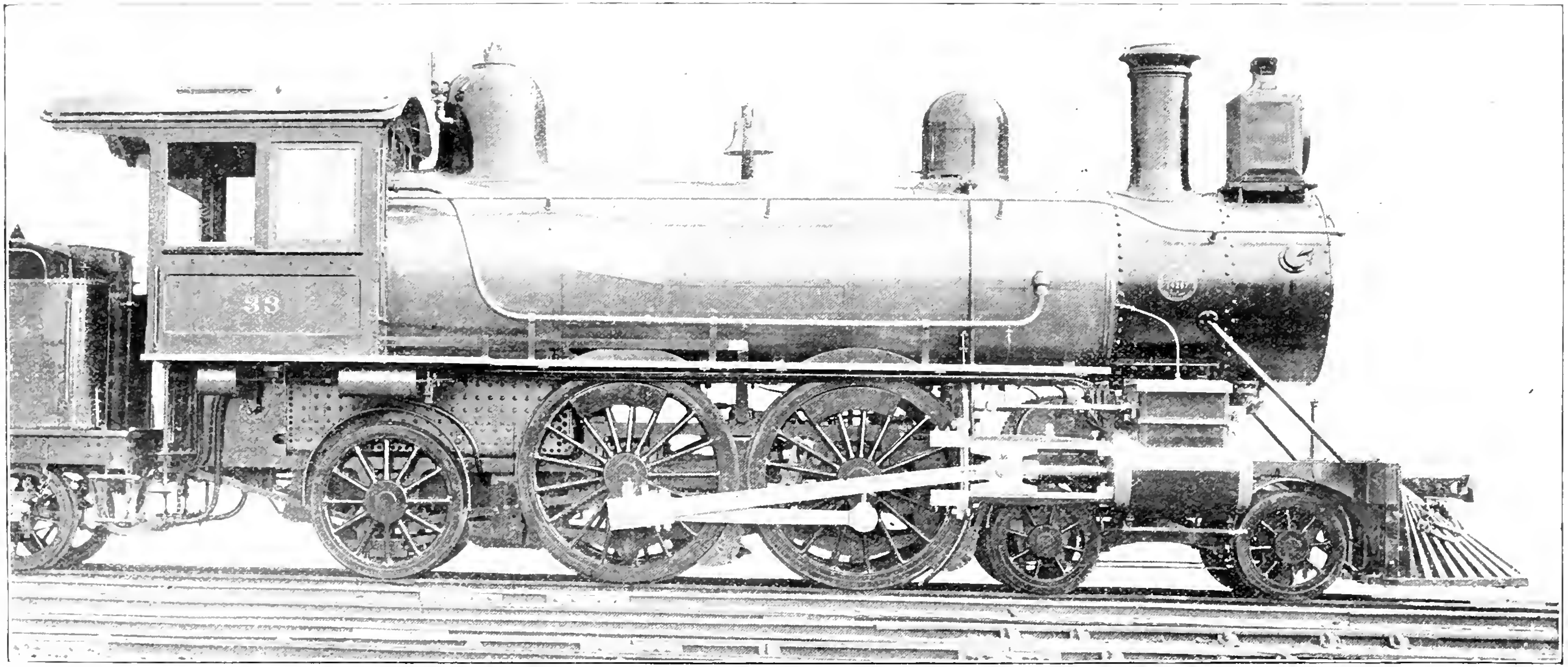
The Railroad Interstate Commission Report for 1894 says:

"During the year 1,823 railway employés were killed and 23,422 were injured, as compared with 2,727 killed and 31,729 injured in 1893. This marked decrease in casualty is in part due to the decrease in the number of men employed, and the decrease in the volume of business handled. The increased use of automatic appliances on railway equipment also may have rendered railway employment less dangerous, and it may be that the grade of efficiency of employés has been raised.

"The number of passengers killed was 324, an increase of 25, and the number injured was 3,304, a decrease of 195. Of the total number of fatal casualties to railway employés, 251 were due to coupling and uncoupling cars, 439 to falling from trains and engines, 50 to overhead obstructions, 145 to collisions, 108 to derailments, and the balance to various other causes not easily classified. To show the ratio of casualty, it may be stated that 1 employé was killed out of every 428 in service, and 1 injured out of every 33 employed. The trainmen perform the most dangerous service, 1 out of every 156 employed having been killed, and 1 out of every 12 having been injured.

"The ratio of casualty to passengers is in striking contrast to that of railway employés, 1 passenger having been killed out of each 1,912,618 carried, or for each 44,103,228 miles traveled, and 1 injured out of each 204,248 carried, or for each 4,709,771 miles traveled. A distribution of accidents to the territorial groups exhibits the diversity in the relative safety of railway employment and of railway travel in the different sections of the country."

The Chicago & Alton have adopted the plan of personal record—Discipline Without Punishment—as first described in LOCOMOTIVE ENGINEERING by General Superintendent Brown, of the Fall Brook road. All employés started with clean records on June 1st. No more suspensions will take place; men will win or lose on their record. This is the only just and decent plan. "Give him thirty days" is easily said, and is said too easily and too often for the good of the service on most roads.



PASSENGER LOCOMOTIVE FOR THE CONCORD & MONTREAL RAILROAD, BUILT BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, PA.

Some Rival Engine Designs.

On this and following page will be found large engravings of two locomotives recently built for service on the Concord & Montreal road.

Practically the same conditions were given to each builder—the two largest in the country—and each has furnished the engine considered the best for the service.

The Baldwin design is the heaviest engine by 11,000 pounds, and she is 500 pounds lighter on her driving wheels than her rival.

Neither of these engines are yet in service—the road department thinking it best to strengthen some of their bridges first—but when put to work, and worn ready for the shop, a comparison of their efficiency, cost of repairs, etc., will be of interest to all railroad men.

Mr. J. T. Gordon, superintendent of motive power, may be depended upon to keep a mechanic's eye on the engines and their work, and we trust he is not the kind of man to keep it all to himself.

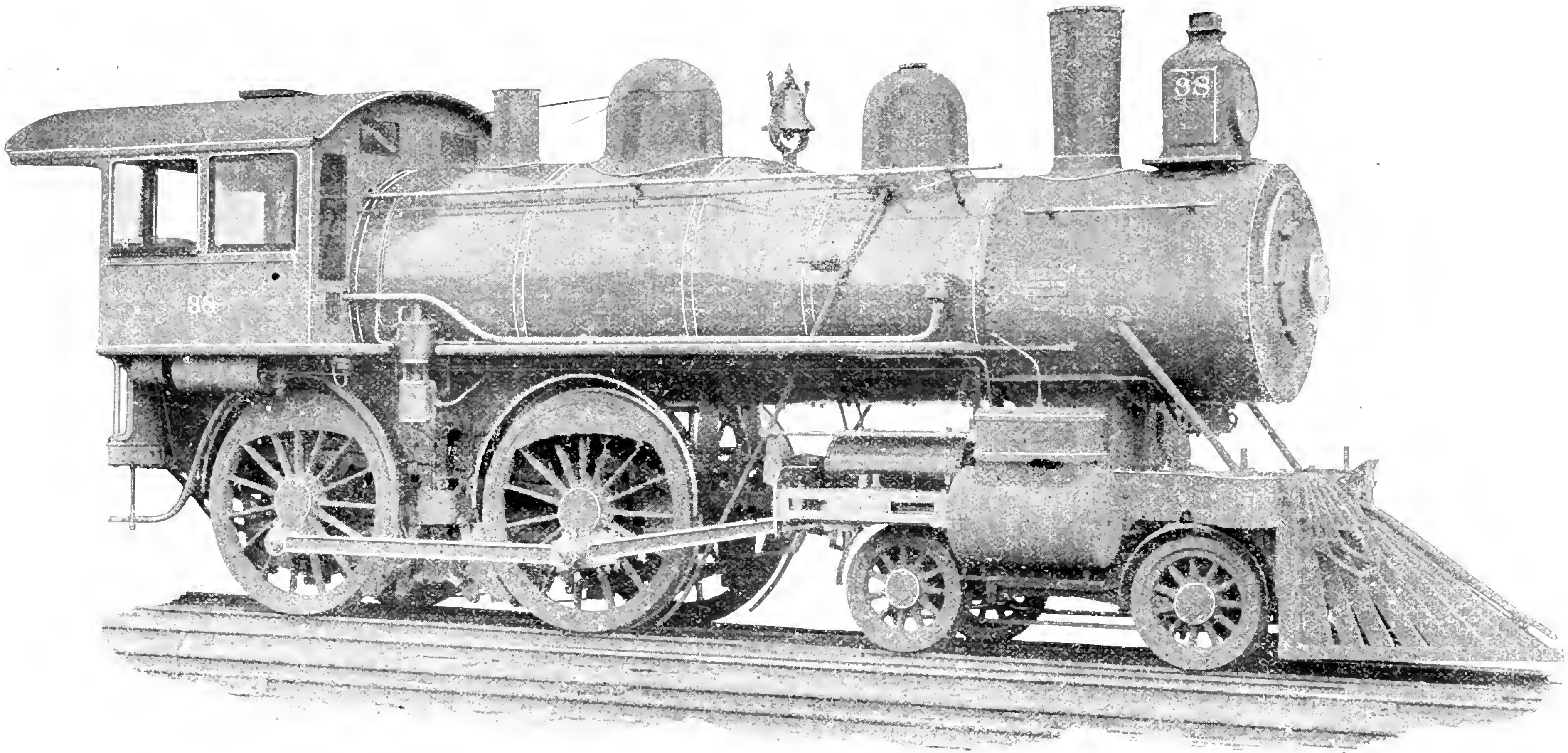
Baldwin Locomotive for the Concord & Montreal Railroad.

Our illustration, for which we are indebted to the *American Engineer and Railroad Journal*, represents an engine just completed for this road, which is of a design that has been recently adopted for a number of locomotives by the Baldwin Locomotive Works. The chief peculiarity consists in locating both the driving axles in front of the firebox, and carrying the back end on a pair of trailing wheels.

The plan has much to recommend it, as it permits the driving wheels being placed as near together as their flanges will allow, and with slightly different proportions at the back end the fire-box could be widened out to any desired width.

The following are the principal weights and dimensions of the engine:

Cylinders, diameter, 19 in.
Piston stroke, 24 in.
Driving wheels, diameter outside of tires, 70 in.
Driving wheels, diameter of centers, 63 in.
Driving-wheel centers of cast steel, tires held by retaining rings.
Boiler, wagon top.
Working pressure, 170 lbs.
Boiler, diameter, 60 in.
Firebox, 89⅜ in. x 42 in.
Tubes, number, 234.
Tubes, diameter, 2 in.
Tubes, length, 14 ft.
Weight in working order, about 128,000 lbs.
Weight on driving wheels, 74,500 lbs.
Weight on front truck, 31,500 lbs.
Weight on trailing wheels, 22,000 lbs.
Total wheel base of engine, 23 ft. 5 in.
Rigid wheel base (including trailing wheels), 12 ft. 6 in.
Spread of coupled wheels, 6 ft. 1 in.
Driving-axle journals, 8 x 10.
Engine truck journals, 5 x 9.
Trailing-wheel journals, 6½ x 10.



PASSENGER LOCOMOTIVE FOR THE CONCORD & MONTREAL RAILROAD. BUILT BY THE SCHENECTADY LOCOMOTIVE WORKS, SCHENECTADY, N. Y.

Tender journals, 4½ x 8.
Diameter of engine-truck wheels, 33 in.
Diameter of trailing wheels, 50 in.
Diameter of tender wheels, 36 in.
Tank capacity, 4,000 gals.

This locomotive is fitted with Westinghouse air brake on driving wheels, tender and train; Westinghouse air signal; consolidated steam-heating appliances; Sherbourne sander; Columbia metallic packing; Nathan sight-feed lubricator; Hancock inspirators. The engine-truck and tender wheels are the Vauclain wrought-iron center steel-tired wheels manufactured by the Standard Steel Works.

Schenectady Locomotive for the Concord & Montreal Railroad.

The accompanying photographic reproduction illustrates a heavy passenger locomotive recently designed and constructed by the Schenectady Locomotive Works for the Concord & Montreal Railroad.

In designing the locomotive, the builders were restricted to a weight on driving wheels not exceeding 76,000 pounds. In order to reduce to a minimum the evil effect of reciprocating parts on the track through the counterbalance of driving wheels, the pistons, crossheads, connecting rods, crank pins and wheel centers were reduced to the minimum weight, so that the effect on the rail at a speed of 60 miles per hour is only equivalent to the ordinary construction of American type of engine with cast-iron driving centers, weighing 9,000 pounds less on drivers.

The driving-wheel centers are of cast steel and of very light weight, crank pins are hollow, while the connecting rods, crossheads and pistons are greatly reduced in section from ordinary practice.

Particular attention was paid to making the locomotive convenient for engineer and fireman. The arrangement in cab of reverse lever, throttle lever and all operating valves is such that they are as conveniently located as in the ordinary American type of locomotive having the deep firebox boiler.

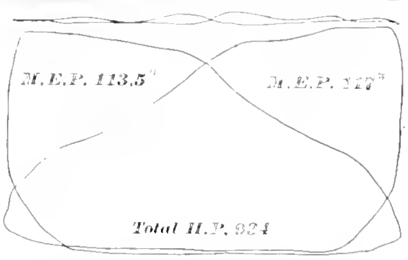
As will be seen by engraving and specifications, the boiler is of the extended wagon-top, radial-stay type, with wide firebox, extending out over frames and over back driving axle, and sloping down towards front end, giving a depth of 25 inches below shell of boiler, thereby allow

ing ample space for fire between grates and firebrick.

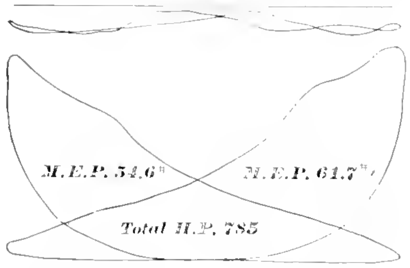
The general design of the engine is similar to the sixteen engines recently built by the Schenectady Locomotive Works for the Boston & Albany Railroad.

The following are the principal dimensions and weight of the engine :

Cylinder diameter, 19 in.
Piston stroke, 24 in.
Driving wheels, diameter outside of tire, 70 in.



N. Y. C. train No. 63, June 8, 1895.
120 revolutions per minute.
25 miles per hour.
195 lbs. gage pressure.
Throttle wide open.
Cut-off, 12"
Vacuum, 4"
Working on 90-foot grade out of Albany.



Locomotive Engineering

N. Y. C. train No. 63, June 8, 1895.
276 revolutions per minute.
57 miles per hour.
186 lbs. gage pressure.
Throttle wide open.
Cut-off, $6\frac{7}{16}$"
Vacuum, 4"

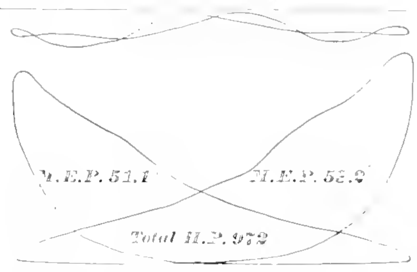
Driving wheels, diameter of centers, 63 in.
Driving-wheel centers of cast steel, tires held by retaining rings.
Boiler, extended wagon-top, radial-stayed.
Working pressure, 190 lbs.
Boiler diameter at front end, 60 in.
Boiler diameter at back end (back head a true circle), 70 in.
Firebox (inside length), 90 in.
Width inside, $40\frac{1}{2}$ in.
Firebox, depth at back end, $61\frac{3}{4}$ in.
Firebox, depth at front end, $73\frac{3}{4}$ in.
Tubes, number of, 299.
Tubes, diameter, 2 in.
Tubes, length, 11 ft. 6 in.
Tubes, space between, $\frac{3}{4}$ in.
Weight of engine in working order, 116,400 lbs.
Weight on drivers, 75,000 lbs.
Total wheel base of engine, 23 ft. 9 in.
Driving-wheel base of engine, 8 ft. 6 in.
Driving-axle journals, 8 x 11.
Engine-truck journals, 6 x 10.
Tender-truck journals, $4\frac{1}{2}$ x 8.
Diameter of engine-truck wheels, 33 in.
Diameter of tender-truck wheels, 36 in.
Tank capacity, 4,000 gallons.
Tender frame is made of $6\frac{1}{2}$ x 4 x $\frac{3}{4}$ angle iron.

The tender trucks are the Schenectady Locomotive Works standard iron truck, with channel-iron floating bolsters and inside brakes.

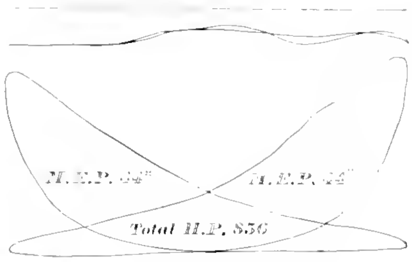
Engine and tender-truck wheels are the Snow boltless steel-tired wheel.

Locomotive is fitted with the Westinghouse air brake on driving wheels, tender and train, Westinghouse air signal, Richardson balance valves, Leach sand-feeding device, Nathan & Co. sight-feed cylinder oiler, Hancock inspirators, and Smith triple-expansion exhaust nozzles.

Previous to the delivery of the locomo-



N. Y. C. train No. 63, June 8, 1895.
200 revolutions per minute.
$41\frac{1}{2}$ miles per hour.
190 lbs. gage pressure.
Throttle wide open.
Cut-off, $6\frac{7}{16}$"
Vacuum, $3\frac{3}{4}$"



N. Y. C. train No. 2, June 11, 1895.
288 revolutions per minute.
60 miles per hour.
185 lbs. gage pressure.
Throttle half open.
Cut-off, $6\frac{7}{16}$"

tive, it was run a few trips on the New York Central Railroad, on heavy, fast passenger trains, and the accompanying indicator cards obtained.

Endurance of Rubber Hose.

There is a vague idea among railroad men that rubber hose used in steam-heating couplers does not last very long, but there is very little accurate knowledge of how long a hose may be depended upon to hold out. Some facts on this subject were given by President Gibbs at a meeting of the Western Railroad Club, which are well worthy of being noted down. Mr. Gibbs said :

"The question of rubber hose for steam heating constitutes a more important one than most people think at first sight. We have been trying to keep a record of the life of our hose, and have done so on the engine hose—that is, hose between the engine and tender and tender and first car—and apparently we find that one-fourth of the hose in use lasts thirty days ; that is, where the engine hauls the train using electric light occasionally, possibly twice a week. In using electric light we have to supply 100 pounds steam pressure. At other times the pressure is less, and the usual average life of hose is forty-five days. In trains using only steam-heating pressure, twenty to fifty pounds, the engine hose lasts about four months ; back in the train between cars, where the pressure is less, the life is about one season. This is only obtained with the very best hose in the market, and we have found the highest-priced hose to be the best and most economical in the end. The life, you see, is very short, and we have taken special pains to increase it by making very solid fastenings from the hose to the shank ; where the fastening is not solid, the life is much less. As hose costs between three and four dollars apiece, it will be seen that this expense is quite an item."

Caste.

Some men like to show off their authority, especially in the presence of ladies. A fresh conductor on a Western line had some of this taint in his blood.

He took out an excursion lately, composed largely of ladies. The conductor had a new uniform and felt his oats, but the girls didn't seem to pay very much attention to him.

At a way station they were side-tracked and delayed for orders, and many of the passengers got out to stretch their legs. The conductor came out of the office, finally, handed the orders to a brakeman to take to the engineer, and when he was half way to the engine called out in a loud voice :

"Tell that engineer that I want him to run twenty-seven miles an hour to the junction !"

The engineer was old and wise in the pride of conductors—and also engineers—and from his cab window he called out to the brakeman :

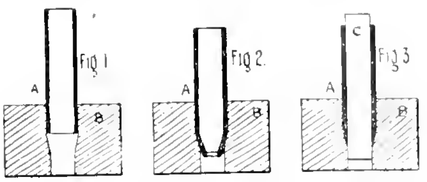
"You go back and tell the drum-major that I am running this engine on orders from the dispatcher, and that he can bring that order to me himself and read it out loud as the rules require. What de ye suppose they give me a clerk for ?"

The conductor had to take the order over, too, and read it out loud.

When the express came, the conductor yelled, "All aboard !" and they pulled out. The last spark of pride was killed in that conductor as he sat on the butcher's chest and heard a young man explain to his girl that conductors were only boss of the brakemen, but that all hands had to mind the engineer. "Why," said he, "the engineer could stop right here and put the conductor off if he wanted to."

Novel Way to Scarf Safe Ends.

At one of the Erie shops—we believe at Galion, O.—they got short of safe ends to weld on to tubes, and also the means of scarfing them. Some handy mechanic suggested the plan shown in the sketch and put it into successful operation. He used the old taper-hole block to reduce the end of the pipe, as shown in Fig. 2. After this is done, they drop a steel punch into



the tube, *C*, Fig. 3, and punch it through; this cuts out the *inside* of the taper piece and makes a nice, clean scarf.

To do this work by power, they utilized the back end of the lever of a heavy punch and shear in the smith shop; by blocking up the right height, the lever came down just far enough to drive the pipe the right length, and then the punch. It is a neat and inexpensive way to scarf safe ends.

Economy in Locomotive Repairs—Increasing the Necessary, and Cutting Down the Unnecessary Work.

When the head of the mechanical department of a road is confronted with the peremptory order to cut his pay-roll 10 or 20 per cent., he is always obliged to do less work. On ninety-nine roads in a hundred this means the running down of the motive power and rolling stock. Boilers that have been carefully inspected every month are let go for three months; tires that were turned for an $\frac{1}{8}$ inch of wear are let run until worn a $\frac{1}{4}$ or $\frac{1}{2}$ inch. Everything is allowed to get into worse condition than it should be. So long as the engines and cars are in condition to run they are not touched—there is no stitch-in-time policy practiced.

If an engine comes in with a broken piston, crank pin, or eccentric, why, it must be repaired; very often nothing else being done.

On most roads it costs a fixed amount of money to replace a broken piston rod, crank pin or eccentric, be the times good or bad. It is well known about how much of the repairs are directly chargeable to break-downs, and all the available money is expended to keep the power moving by repairing break-downs and letting wear take care of itself.

On the Missouri Pacific a different plan was tried, and we think it shows better management.

Superintendent of Motive Power Mr. Frank Reardon, ably seconded by his general foreman, Mr. Thomas Fieldin, commenced to figure, not how to do certain work cheaper, but how to avoid doing work not absolutely necessary. It is interesting to follow some of the pieces of locomotives that they took in hands to cheapen.

To begin with, they took their front cylinder heads. These are usually cast solid, are turned on both sides, the stud holes laid off with dividers, or a template used, and all holes drilled to size of studs; the piece has to be turned around in the lathe to face the back, and is also turned on the edge. This costs money and takes time. They arranged to have all front cylinder heads of a given size, made from one pattern, for all makes of engines.

As the front is covered up by casing, anyway, they decided to leave it rough, the edge the same; making the pattern a little smaller in diameter than the cylinder flange did away with the necessity of turning the edge.

As the joint holds the head in position, and all that is required of the studs is to hold the head *against* the cylinder, the holes were cored out and left plenty large, so as to insure the head going on without filing of holes to accommodate slightly bent studs.

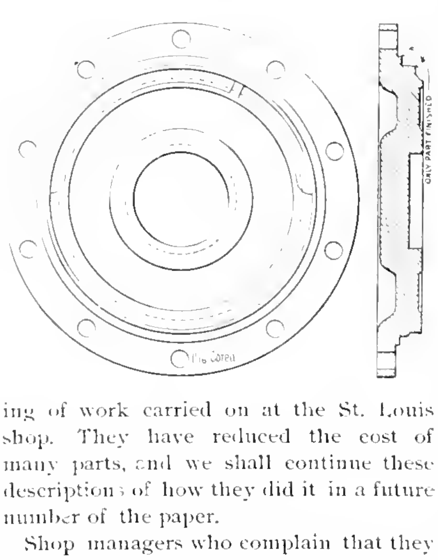
As the inside face of cylinder head touches nothing, no good reason could be found for machining that.

Thus, by *not* doing a lot of things always considered necessary, they found that on front cylinder heads the only actual machine work necessary was the joint, and the turning back of the shoulder to admit the center of head into counterbore the proper distance for the make of engine being repaired.

If one of their 20-inch engines knocks out a front head, they take a rough casting from the yard, put it on a lathe and do all the machine work needed in thirty minutes—can get a head ready almost while engine is being gotten into the house. This saves several hours of time, and reduces the cost for machine work to cents where it was dollars.

Steam chest covers are used rough, except at the joint.

This is by no means the end of the sav-



ing of work carried on at the St. Louis shop. They have reduced the cost of many parts, and we shall continue these descriptions of how they did it in a future number of the paper.

Shop managers who complain that they do not have the men nor the means to keep up their repairs might do well to study on these lines—how to find and stop doing unnecessary work. They may find they have more time and money to keep up running repairs than they thought.

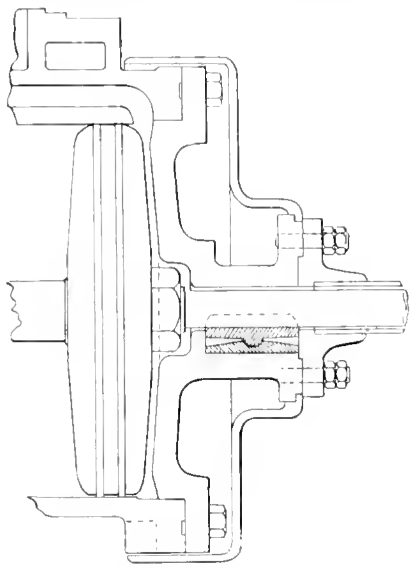
Is it not true that a great deal of unnecessary work is done on engines that can be discontinued, and the time and money used to do it diverted to more useful work?

We are inclined to think there is a chance for every shop foreman and master mechanic to make a marked saving right on these lines.

Supporting Extension Piston Rods.

While so much is being said about the support of tail rods—extensions of piston rod through the front head—it may be well to inquire into the merits of an old device, in use on the P. R.R. for the past seven or eight years.

They have a lot of Class I engines with tail rods; the rod is supported in a half brass, somewhat resembling an inverted car brass, made as shown in the shaded por-



tion of our sketch. The rod is covered by a pipe or sleeve, and no attempt made to pack against the pressure entering it around the rod.

What is wrong with this support? It is cheap, self-lubricating, and ought to carry the weight of piston for a long time without getting out of line; if wear takes place, a shim under the shoe puts the rod back in the center of the cylinder.

The latest paper on the market is entitled *American Engineering*. It hails from Brooklyn, is edited by Frederick Keppy, the well-known subscription agent, of Bridgeport, Conn., and is only fifty cents a year. The announcement says that it is intended to interest the four hundred thousand steam engineers in the country. There are already too many poor papers and not enough good ones. If this one proves good, it will be a success; if bad, it will die easily and early. Here's a health to you, *American Engineering*!

LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Publishers' Notice.

For some time the publishers of LOCOMOTIVE ENGINEERING have had under advisement a plan for putting this publication on a still higher plane—it has led in other improvements and proposes to lead in this.

There are two kinds of railroad mechanical papers—those that live on the advertisers and have few readers, and the one that is supported mostly by subscriptions—that is this paper; there are no others of the same class. Advertising papers make a practice of printing in their reading columns almost any cuts of proprietary devices their advertisers furnish, be they new or old, interesting or not.

Some, with a spark of pride left, demand at least "simultaneous" publication with similar sheets—cuts are usually sent broadcast to all. There are one or two that demand "first publication," and won't print the matter if they don't get it first. This is assuming that their readers have no right to know about improvements in machinery, etc., whose makers decline to give the said paper first publication of.

LOCOMOTIVE ENGINEERING'S twenty-odd thousand subscribers pay their two dollars to know what improvements *are* made, and we propose that they shall know, and to that end have made the following rule, to take effect on and after July 1st.

We will not use cuts or electrotypes of proprietary devices furnished by anyone. We will illustrate and describe, in our own way, and at our own expense, any device or part of a device that we think of interest to our subscribers.

We ask those who have new or improved devices to send us photographs and drawings from which to make our own engravings. Whether they are advertisers or not will make no difference. If the device is of interest, in our judgment, we will illustrate it as much as it deserves—and no more.

It is not necessary to show a whole lathe to describe John Smith's improved tool post. Spread-eagle electros, "sent out to all the papers alike," will bring three-quarters of a cent per pound for scrap in this office, unless their return at owner's expense is requested.

Anything worth doing is worth doing well. LOCOMOTIVE ENGINEERING now has the reputation of being the one railroad paper *that is read*. We "love, honor and obey" these readers, and propose to give them the worth of their money. Such a paper is ten times a better advertising medium than one filled with parts of dealers' catalogues, and that re-illustrate the same tool about once in two years.

It costs money to make cuts in this way, but LOCOMOTIVE ENGINEERING can stand the expense of being fresh, original, and the leader. We believe our readers will appreciate this move, and our advertisers ought to—and we believe they will.

SINCLAIR & HILL.

Boiler Covering.

The constant agitation kept up by railroad mechanical associations and clubs in favor of methods for improving railroad rolling stock, and the incessant criticism of bad practice in any detail, are leaving very little that requires to be altered for the better. There is, however, one weak spot left on the majority of locomotives which deserves the attention of the reformers. This is the material used for boiler covering. Probably 90 per cent. of our locomotives are lagged with pine boards, which are covered with a jacket of planished iron. There is nothing to recommend this style of covering except that it is cheap, easy to apply and easy to remove for examination. Wood itself is a fair non-conductor of heat, but it shrinks so much when used as boiler covering that currents of air constantly pass through the openings, carrying away the heat. The increasing heat of boilers, due to high steam pressure, makes wood lagging very liable to take fire. Burning lagging on an engine pulling a fast train is a very troublesome thing, to say the least. When lagging once takes fire, the small original efficiency of the boiler covering is impaired, and the liability of the stuff to take fire again is increased. It is a common thing to find the lagging almost entirely burned out when an engine gets into the shop for a general repair. There may be railroads where boilers are stripped and the lagging repaired when it has taken fire, but that is not the common practice.

People, as a rule, do not realize the magnitude of the heat loss due to radiation from the outside of boilers, or there would be more attention devoted to restraining the same. Mr. E. M. Williams, mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, in a paper read at the Northwestern Railway Club, said: "Scientific tests have shown that the average saving in one year by covering a 2-inch pipe 100 feet long, carrying 60 pounds of steam, is equal to five tons of anthracite coal. That weight of coal would be required to vaporize the water of condensation were the pipes left uncovered."

Careful experiments, conducted a few years ago by Mr. J. C. Hoadley, an eminent engineer, indicated a loss of about 12 per cent. from the radiation of an uncovered boiler in the open air. This was reduced more than one-half when the boiler was carefully covered. A locomotive rushing through the atmosphere will cause much greater radiation of heat from the boiler than what occurred in the experiments mentioned. The current of cold air that passes in through the openings of a badly covered boiler must act like a condenser. On every road in the country there are complaints that engines steam worse in winter than in summer, and it is a common practice to reduce the size of the nozzles in winter. There is no reason why this should be so, except that a larger percentage of the heat is being absorbed by the cold air. Between the wood lagging of locomotives, in its average condition, and the best form of boiler covering to be found, there is probably a difference of 6 per cent. in the capacity to save heat. The locomotives in the United States and Canada use an average of about 60 pounds of coal per train mile. It is safe to say that $3\frac{1}{2}$ pounds of this is wasted through radiation that could be prevented. When this is figured up, it shows that a little extra money spent on good lagging would be a remarkably good investment.

The question naturally arises, Why is this waste of heat permitted, when it could be stopped so easily? The answer is that the extent of the waste is not forcibly visible. The varieties of improved lagging which have been urged upon the railroads that have tried to get something better than pine wood, were in many cases a disappointment. The most common form of improved boiler covering is a plastic composition, made of asbestos mixed with lime, plaster of paris, or other sticky ingredient. This makes a very inferior boiler covering, for the mixture is a much better conductor of heat than wood is. Another practice, which is wrong, is to use asbestos or other non-inflammable material pressed into boards. That makes a very poor covering for keeping in the heat.

The best form of non-conducting material for covering boilers is hair felt. The cause of its efficiency is that it is full of air spaces. Any material which is of a spongy character is a good non-conductor, because the air filling the small cavities is a very sluggish conductor of heat. Taking hair felt as the best non-conductor attainable, it follows that the mineral substitutes in use should approach the condition of hair felt as nearly as possible. That is, it should be finely subdivided, so that when it is applied to the boiler the mass will have a cellular character.

A plastic boiler covering might be used efficiently, with an air space between covering and boiler. The air would make up for the shortcomings of the plaster. Those using plastic material directly upon the boiler plates would do well to investigate the character of the mixture. Plaster of paris, which is sulphate of lime, is frequently a part of the composition. If there should be a leak where this material is used, the sulphuric acid in the lime is liable to attack the iron.

There appears to be every reason why sectional boiler covering should be used, made of mineral wool, magnesia, asbestos or other mineral fiber made up in felt-like shape. This certainly would be efficient as a protector of heat, and it could easily be removed for examination of the boiler. A material which cannot be taken off without damage is not a convenient boiler covering.

A portion of the boiler nearly always neglected of covering is the firebox. The sides of the firebox are difficult to cover, but there is no reason why the front of the firebox should not be thoroughly protected from the cold. The surface exposed there is not great, but it receives the full blast of the cold air. We believe that more heat is lost on that spot than in ten times its area in other parts of the boiler, for a flat surface of the hottest part of the boiler is most directly exposed to the wind.

Practical Training for the Young Mechanical Engineer.

We listened lately to a consultation between a professor of an engineering school and the parent of a graduate, concerning the best practical training for the young man to provide him with the capital of experience required to prepare him for rising in the profession. The father was inclined to think that a few years' work in a country machine shop near his own home would be of great service to his son, but the professor argued that the best kind of practical training for a young engineering graduate was in a first-class shop, where the most advanced modern methods of manufacture are in vogue. He insisted that the young man being ambitious to become a superintendent or manager of a manufacturing machine shop, his best training was necessarily in a field where the most approved appliances were in use. Then all the rising engineer would require to do was to make him familiar with the handling of special tools and learn their capacity. The advice thus given was followed.

We have cogitated ever since over this question, and have come to the conclusion that the first impulse of the parent was the right one for the best interests of his son. There is a tendency among those who have been trained in first-class machine shop surroundings to look down upon the "backwoods machinist;" but there are advantages in the training of the latter which make him much more efficient in overcoming difficulties than the man who has always been accustomed to find suitable tools for every operation he was called upon to perform. A youth who has received the training of an engineering school, and expects to push rapidly ahead into the designing of machinery and management of work, naturally thinks that it is not necessary to go through the drudgery that a man learning to be a broad and first-class machinist must undergo; but the training and experience which are necessary to make a first-class machinist will be found of great advantage to a mechanical engineer.

The training to do work under difficulties which an apprentice in a country machine shop receives, gives him confidence in overcoming obstacles, and develops the inventive faculty as an aid in everyday operations. Necessity is the mother of invention, but if the necessity does not arise early in life, a man's natural ability to devise the appliances which necessity demands is likely to be stunted for want of practice.

It is well known that machinists trained in first-class shops, where regular appliances and tools are provided for every operation, are very helpless when called upon to do work which is out of the regular routine, and calls for methods or appliances they have not been accustomed to. The sub-division of labor in mechanical manufacturing establishments tends to develop good specialists, but narrows the experience of individual workmen. A young engineer who goes into such a shop to gain experience will be liable to come short of his expectations, unless he is specially favored by being passed through the various departments. But even when he enjoys this favor, he merely learns to do things which other men have devised the tools for. The training he receives inclines him to depend upon others for providing the means and methods of production. It is safe to say that most of the ingenious labor-saving and production-facilitating tools used in our most celebrated shops have been devised by men who were trained in shops that threw the workmen upon their own resources.

A young engineering graduate seeking a field of experience ought certainly to choose that in which he is likely to be thrown most upon his own resources, or where he would see others improvise means for overcoming difficulties in doing work. Where all operations in a machine shop move like clockwork, where designs are prepared by first-class draftsmen, patterns made that any molder can use, forgings turned out that conform closely to the finished article, there is little scope left for individual ability, and there is small opportunity for developing the natural ability a man may have. In the small jobbing shop with few tools, on the other hand, all the surroundings promote self-reliance and develop ingenuity. The inventive man comes readily to the front; the man deficient in self-help falls behind. This species of experience is not pleasant, but it gives the right man a fund of resources that make him valuable when he takes charge of work. He will go into a first-class modern shop filled with labor-saving appliances that he never heard of before, and within a few months he will be improving upon them.

To Prevent Heavy Locomotives from Damaging Rails.

The general superintendent of one of the most important Western railroads has issued an order which is worthy of imitation by every railroad company interested in preventing damage to track. Much of the damage done to track by heavy locomotives might easily be avoided, if an intelligent supervision were exercised over locomotives under the circumstances most likely to result in injury from the effect of destructive, unbalanced forces. The circular referred to says:

"Consolidation engines will not hereafter be permitted to run at a rate of speed exceeding 30 miles per hour in any branch of service. Engines running on one side, or without parallel rods, must not exceed 20 miles per hour. Trains hauling dead engines, disconnected must not exceed 20 miles per hour. Engines operating upon branches or in yard service distant from shops, must not be ordered over the main line to the shops for repairs until a representative of the locomotive and car department has examined them, and reported that they are safe to be moved. In making such examination, particular attention must be given to the inspection of tires. An engine with a flat tire must not be run over the road under any circumstances. When yard engines are moved outside of yard limits, they will in no case be allowed to exceed 15 miles per hour."

Interstate Commerce Law on Height of Drawbars and Grab-Irons Now in Force.

A great many of of our railroad companies appear to have forgotten that the Interstate Commerce Law requires that all cars shall be provided with grab-irons or handholds and drawbars of a standard height by July 1st of this year. That date has passed, and thousands of cars do not com-

ply with these inexpensive requirements. It may be of interest to all concerned to remember that men hurt by cars not complying with the law in this respect are not open to the charge of contributory negligence. When damages are sued for, the company at fault has no resource but to pay up.

At the last Master Car Builders' Convention, Rule 8 of the Interchange of Cars had a paragraph added, which reads:

"Car owners will be chargeable with the repairs of their own cars when such repairs consist of raising a car so that the drawbars will come within the standard limits of $31\frac{1}{2}$ inches to $34\frac{1}{2}$ inches from top of rail to center line of drawbar, or, when they consist of the addition of hand-holds or grab-irons to the car, all to conform with the requirements of United States law in these respects."

This is a very proper move, since it enables railroad companies desirous of complying with the law to protect themselves against those which have ignored the legal requirement.

Why the Chicago Plan of Interchange Failed of Adoption.

The Chicago plan of interchange—inspection for safety only—was voted down in the Master Car Builders' Association meeting, at Alexandria Bay, last month. There were a great many surprises when the test vote was taken. Men who were supposed to be lukewarm on the subject were found to be ardent supporters, while others, who had been foremost in advocating the plan, voted against it. Many men expressed themselves as personally in favor of the plan, but voted against it because they were so instructed.

The immediate adoption of this just and sensible plan was defeated by roads whose officers are interested in private car lines. Under the present plan, the railroads keep up, in a great measure, the running repairs of private line cars. The new rule would make the owners pay their own bills—which goes against the grain.

It is to be hoped that another year's trial of the Chicago plan will prove its value *to railroads*, so that they can afford to enforce its adoption, if not by the Car Builders' Association, then by agreements of their own.

It will seem strange to refuse to adopt the plan, and yet go on using it, as twenty or more roads undoubtedly will do.

If the Master Car Builders' Association Committee on Subjects for Investigation have not got their list full, we would suggest a line of inquiry which would be very profitable to railroad companies. A very exhaustive series of tests of brakes were made last year on the Nashville, Chattanooga & St. Louis. One of the tests consisted of kicking a Pullman car, and then a day coach belonging to the N. C. & St. L., into a speed of thirty miles an hour, and then applying the brake. The Pullman car ran 416 feet before it stopped, and the time taken was 18 seconds; the railroad company's car ran 202 feet, and was stopped in 10 seconds. This underbraked condition of Pullman cars is notorious, and yet very little has been said about it. There is nothing connected with train operating so much in need of a thorough investigation that would make clear the extent of this source of danger.

It was the general expression by supply men that the Master Car Builders' Association placed the price of knuckles and couplers too low for good material. A first-class steel knuckle can hardly be furnished for \$1.50—the first price adopted was \$1.

We cannot publish particulars of fast runs; if we do this for one, we should for all, and the office is now flooded with accounts of good runs by many engineers far and near. Every man has a chance sooner or later to make a fast run—but, after all, they are very much alike, and not of general interest.

BOOK REVIEW.

THE MODERN MACHINIST; a Practical Treatise on Modern Machine Shop Methods. Illustrated by 257 engravings. By John T. Usher. Published by Norman W. Henley & Co., New York. Price \$2.50.

This is a new work of merit; it does not contain descriptions of machine tools, but of special tools and appliances, methods and plans of doing work with them. All of the engravings are original, and two-thirds of them drawn in perspective, which adds to their value. The book is one that every mechanic should have.

There is much diversity of opinion among master mechanics as to the effect of sand on the wear of tires; but railroad men in Florida and other sandy regions are a unit in believing that sand causes more wear than that due to abrasion. At a meeting of the Southwestern Railway Club, Mr. George B. Harris, of the Georgia Southern, said that on the southern end of his road a tire would not run more than 40,000 miles without turning, while on other parts of the system three times that mileage could be obtained. Mr. C. B. Gifford, of the Louisville & Nashville, said that engines running out of Birmingham would make from 120,000 to 150,000 miles between the turnings of the tires, while on the sandy Pensacola division the wear was so excessive that engines could not make more than 35,000 miles before the tires needed turning. This ought to convey a moral.

We will give \$1 for Nos. 7, 8 and 11 of Volume 4 (1891) of this paper. Write before sending.

PERSONAL.

Mr. G. W. Eaves has resigned as master mechanic in charge of the repair shops of the Seaboard Air Line, at Raleigh, N. C.

Mr. Leads Kingman has been appointed chief engineer of the Mexican Central Railroad. He was for some time city engineer of Topeka, Kan.

The jurisdiction of Mr. Huffsmith, master mechanic of the International & Great Northern, has been extended over the car department of that road.

Mr. H. T. Henderson has been appointed superintendent of the Chickamauga & Durham, to succeed J. I. Henderson, deceased. Headquarters, Chickamauga, Ga.

Mr. A. K. McCown, formerly superintendent of the Middlesboro Belt, has been appointed assistant master of transportation of the Plant system at High Springs, Fla.

Mr. J. W. Dalbey, superintendent of the Kansas City Northwestern, has been appointed superintendent of the Kansas City and Beatrice also. Headquarters, Kansas City, Mo.

We regret to learn that Mr. W. E. Symons, master mechanic of the Atchison, Topeka & Santa Fé, at Raton, N. M., is lamenting the loss of his wife, who died last month.

Mr. J. B. Dorsey, for several years master mechanic of the Ohio River Railroad, has resigned. He is open for a new engagement, and has the reputation of being a first-class man.

Mr. Richard Fitzsimmons has been appointed acting master mechanic of the Mexican National, with charge of motive power and car department, in place of Robert Dewer, resigned.

Mr. A. O'Hara, trainmaster, has been appointed superintendent of the Kansas division of the St. Louis & San Francisco, with office at Neodesha, Kan., in place of Mr. L. D. Button, transferred.

Mr. T. A. Switz has been appointed assistant to the general manager of the Minneapolis, St. Paul & Sault Ste. Marie, in addition to his duties as purchasing agent. Headquarters at Minneapolis, Minn.

Mr. G. W. Phelps has been appointed superintendent of the Western Railway of Guatemala, with headquarters at San Felipe. Mr. Phelps was formerly with the Southern Pacific at San Francisco, Cal.

We should feel under obligation to our friends if they would send us notice of promotions and changes as they occur. We often receive complaints of not mentioning promotions, when we had no means of learning about them.

Mr. James Maglenn has been appointed master mechanic of the shops of the Seaboard Air Line, at Raleigh, N. C., to succeed Mr. G. W. Eaves, resigned. Mr. Maglenn was formerly superintendent of motive power of the road.

Mr. Frank J. Pease has been appointed acting master mechanic of the Toledo, St. Louis & Kansas City, instead of superintendent of motive power, as formerly stated. He was formerly general foreman of the shops at Frankfort, Ind.

Mr. L. D. Button, superintendent of the Kansas division of the St. Louis & San Francisco, has been transferred to and appointed superintendent of the St. Louis division, with office at Springfield, Mo., in place of Mr. W. A. Thoms, deceased.

Mr. Clarence N. Mendenhall, assistant road foreman of motive power of the Philadelphia, Wilmington & Baltimore, has been appointed superintendent of motive power of that road, with headquarters at Philadelphia, Pa., to succeed Mr. Robert E. Marshall.

Mr. A. E. Benson, who has been for the last fifteen years master mechanic of the Ulster & Delaware, with headquarters at Rondout, N. Y., has been promoted to be general superintendent of the road, and Mr. A. W. Belcher has been appointed master mechanic.

Mr. William N. Bannard, superintendent of the Altoona division of the Pennsylvania railroad, has been appointed superintendent of the Philadelphia, Wilmington & Baltimore, with headquarters at Wilmington, Del., to succeed Mr. E. F. Brooks, transferred.

Mr. Robert E. Marshall, superintendent of motive power of the Philadelphia, Wilmington & Baltimore, has been appointed superintendent of the Altoona division of the Pennsylvania Railroad, with headquarters at Altoona, Pa., to succeed Mr. W. N. Bannard.

Mr. C. A. Hammond, formerly superintendent of the Boston, Revere Beach & Lynn, and secretary of the American Society of Railroad Superintendents, has been appointed general manager of the Standard Railroad Equipment Company of New York, with office at 143 Liberty street.

Mr. Harry McIlwain has been promoted to be foreman of the erecting and repair department of the Union Car Works at Depew, N. Y. He is a son of Mr. J. D. McIlwain, the well-known master car builder, and was for two years one of the master mechanic scholars at the Stevens Institute of Technology.

Mr. John D. McIlwain, for some time superintendent of the Union Car Company's Works, at Buffalo, has accepted the position of superintendent of the Schoen Mfg. Works, at Pittsburgh, Pa. Mr. McIlwain has had much experience with the working of steel for cars, and will prove a valuable assistant to Mr. Schoen.

Mr. Edwin G. Russell, superintendent of the Rome, Watertown & Ogdensburg, has been offered the presidency of the Brooklyn Heights Railroad Company, at a salary of $12,000 a year, and it is stated that he will accept the position. Mr. Russell has been with the R., W. & O. since Feb. 1, 1893, and was formerly for five years connected with the Illinois Central.

Mr. E. E. Calvin has been appointed general superintendent of the International & Great Northern, succeeding T. G. Golden, resigned. He will have charge of the maintenance of way, transportation, mechanical and telegraph departments. Mr. Calvin was formerly superintendent of the Idaho division of the Union Pacific, at Pocatello, Idaho, and came there from the Missouri Pacific.

At the last Convention of the Railway Master Mechanics' Association, Professor Goss, of Purdue University, Lafayette, Ind., was elected an associate member, and the same honor was conferred upon Mr E. L. Coster, 10 Wall street, New York. Mr. J. S. McCrum, of the Kansas City, Ft. Scott & Memphis, was made an honorary member; also Messrs. Wm. Lannon, A. G. Eastman and S. A. Hodgman.

Mr. E. F. Brooks, superintendent of the Philadelphia, Wilmington & Baltimore, has been appointed superintendent of the New York division of the Pennsylvania railroad, with headquarters at Jersey City, N. J. He has been superintendent of the P., W. & B. since March 1, 1893, and previous to that date was engineer of maintenance of way of the United Railroads of New Jersey. He succeeds Mr. Joseph Crawford, resigned on account of poor health.

Mr. A. L. Hopkins, formerly second vice-president of the Missouri Pacific, and recently appointed receiver of the Chicago & Northern Pacific, was on June 14th chosen president of the New York, Susquehanna & Western, to succeed Mr. Simon Borg, resigned. Mr. Hopkins entered railway service in 1867, and was for one year connected with the machinery department of the Housatonic. He has always taken a warm interest in the mechanical department, although he rapidly rose into the higher branches of railroad service.

There was considerable pleasantry between Mr. J. O. Pattee, of the Great Northern, and Mr. John Mackenzie, of the Nickel Plate, at the Master Mechanics' Convention, owing to a resemblance of face which caused Mr. Pattee to be mistaken for Mr. Mackenzie by various persons. When Mackenzie was told that people were mistaking Pattee for him, he protested that he would jump into the river if he was not a better-looking man than Pattee. On this remark being carried to Pattee, he declared that he would have been ashamed to ask a woman to be his wife if he was not better-looking than John Mackenzie.

The officers elected for the coming year by the American Railway Master Mechanics' Association, at Alexandria Bay Convention, were: President, R. C. Blackall, superintendent of motive power, Delaware & Hudson Railroad, Albany, N. Y.; First Vice-President, R. H. Soule, superintendent of motive power, Norfolk & Western Railroad, Roanoke, Va.; Second Vice-President, Pulaski Leeds, superintendent of machinery, Louisville & Nashville Railway, Louisville, Ky.; Secretary, Angus Sinclair, editor LOCOMOTIVE ENGINEERING, New York; Treasurer, O. Stewart, superintendent of motive power, Bangor & Aroostook, Oldtown, Me.

During the last day of the Railway Master Mechanics' Convention a number of ladies, wives of members, met in the parlor of the Thousand Island House to give expression of thanks to the Entertainment Committee for the handsome manner in which they had been entertained during the convention. All were highly enthusiastic in praising the arrangements carried out for their comfort and pleasure, and the prevailing opinion was that some means should be taken to give public expression of their appreciation of the kindnesses received. Among the ladies who desired their thanks to be publicly tendered were Mrs. J. H. McConnell, Mrs. A. E. Manchester, Mrs. J. O. Pattee, Mrs. W. Garstang, Mrs. Z. T. Sprigg, Mrs. Mord Roberts, Mrs. J. H. Setchel and Mrs. P. H. Minshull. Mrs. McConnell was delegated to see Secretary Sinclair and ask him to make public the sentiments expressed at the meeting.

A remarkably able paper on "Discipline" was read by Mr. William Gibson, division superintendent of the Cleveland, Cincinnati, Chicago & St. Louis, at a meeting of the officials of the railway system named. Mr. Gibson wishes to follow to some extent the system of Discipline Without Punishment, made popular by Mr. G. R. Brown, general superintendent of the Fall Brook Railroad, particulars of which were first given to railroad men by an article contributed by the author to LOCOMOTIVE ENGINEERING. Mr. Gibson wishes to modify the system to suit the conditions peculiar to his road, but the prevailing sentiment is to treat men as men, and not to assume that railroad officers hold a monopoly of good sense, and that the subordinates imbibe of that element merely what overflows from the abundance of their superiors. We expect soon to find room to give full particulars of Mr. Gibson's ideas. The views expressed by Mr. Gibson were highly commended by President Garstang in his opening address at the Railway Master Mechanics' Convention.

E. G. Newhall & Co., of Detroit, are meeting with good success and large sales on their "Detroit Ground Crystal" compound, for welding, tempering, brazing and hardening. They are sending out samples on trial, and in every test, they are informed, it has proved to be superior to all other compounds. They request everyone to investigate their claims and test the merit of its work.

BOILER-MAKING—III.

By C. E. Fourness.*

BOILER SEAMS—*Continued.*

The Figs. 11 to 14 show some of the prevailing straight seams in use. I would state that all straight seams of boilers made of heavier material than ½ inch should be butted, not lapped. Notice in Fig. 12 that seam has a strength of 87 per cent., but,

TABLE No. 3.

SHEARING STRENGTH OF RIVETS. STRAIN TO BE IN THE PROPORTION OF 38000 LBS PER SQUARE INCH OF SECTIONAL AREA.

DIAMETER OF RIVET	3/8"	7/16"	1/2"	9/16"	5/8
SHEARING STRENGTH	5711	7459	9443	11658	14106
DIAMETER OF RIVET	11/16"	3/4"	13/16"	7/8"	15/16"
SHEARING STRENGTH	16784	19699	22849	26227	29845
DIAMETER OF RIVET	1"	1 1/16"	1 1/8"	1 3/16"	1 1/4"
SHEARING STRENGTH	33691	37772	42085	46633	51414
DIAMETER OF RIVET	1 5/16"	1 3/8"	1 7/16"	1 1/2"	
SHEARING STRENGTH	56426	61674	67150	72865	

on account of its being lapped, if it were strained, the sheet would have a tendency to pull in a straight line, causing the sheets to bend sufficiently at *KK* to allow this (as shown in Fig. 15). This would cause the sheets to corrode along the edge of the inside strap; it also exposes the rivet to a partial tensile strain. I would state the Hartford Inspection & Insurance Co. allow only a shearing strain of 38,000 lbs. in single, and 85 per cent. additional, or 70,300, for double shear of iron rivets in steel sheets. But a great many consider it an advantage to have the excess of strength in the sheet, as it generally receives the greatest punishment or abuse in working; also, the sheet corrodes, wastes away and becomes weak in use much sooner than the rivets. But if the diameter of the rivets in Fig. 12 be increased $\frac{1}{16}$ in., then, by using a shearing strength of 38,000 lbs., the per-

TABLE No. 4

STRAIN ALLOWED ON STAYBOLTS (12 THREADS PER INCH) OF DIFFERENT DIAMETERS. STRAIN NOT TO EXCEED 6000 LBS PER SQUARE INCH OF SECTIONAL AREA. AREA TAKEN AT THE BOTTOM OF THE THREAD. THE DIAMETER AT THE BOTTOM OF THE THREAD EQUALS THE SIZE OF THE DRILL REQUIRED TO DRILL STAYBOLT HOLES IN SHEETS.

DIAMETER OVER THE THREAD	DIAMETER AT BOTTOM OF THREAD	AREA AT BOTTOM OF THREAD	TOTAL STRAIN ALLOWED	DIAMETER OVER THE THREAD	DIAMETER AT BOTTOM OF THREAD	AREA AT BOTTOM OF THREAD	TOTAL STRAIN ALLOWED
5/8"	17/32	.2216	1330	1"	29/32	.6450	3870
11/16	19/32	.2768	1661	1 1/16	31/32	.7370	4422
3/4	21/32	.3382	2029	1 1/8	1 1/32	.8051	4830
13/16	23/32	.4057	2434	1 3/16	1 3/32	.9395	5637
7/8	25/32	.4793	2876	1 1/4	1 5/32	1.049	6299
15/16	27/32	.5591	3355	1 5/16	1 7/32	1.166	6998

centage of strength would be (area of a ⅞-in. hole equals .6013), and .6013 × 38,000 × 5 = 114,245; then 114,245 ÷ 134,062 = 85 per cent. This, I consider, would be a good, fair allowance for this seam, as the strap has an offset, that being a certain amount of weakness. In Fig. 13, if the strength of the rivets were based upon a shearing strength of 38,000 lbs. per square inch, a strength of only 8[illegible] per cent. would be secured; but, by increasing the diameter of the rivets $\frac{1}{16}$ in., the joint will be weakest through *AA*. But it will still have a strength of slightly over 93 per cent. Fig. 14 is, in my opinion, the best seam of all, especially for higher pressures and thicker material; it is used a great deal on boilers carrying high pressures. It is a butt joint, consequently the sheet pulls in a straight line; also, the shearing strength of the rivets is higher (even with a shearing strength of 38,000 lbs.), as the majority of the rivets are in double shear. There is, of course, more labor and material required, but it is a much better seam. As stated previously, the Hartford Boiler Inspection & Insurance Co. use a shearing strength of 38,000 lbs. per square inch for single, and 70,300 for rivets exposed to double shear. The British Board of Trade & Admiralty also use the same resistance. Table No. 3 will contain the shearing strength of different-sized rivets at 38,000 lbs. per square inch. Then take your choice.

FLAT SURFACES.

Flat surfaces are stayed in different ways, depending upon the location principally. When surfaces of two sheets occupy positions parallel, or very nearly so, to each other, they are generally braced or stayed by stay-bolts. There are two points to be considered in this work: first, the

TABLE No. 5.

EXTREME PITCH OF STAYBOLTS. THE STRENGTH OF THE STAYBOLTS BEING CONSIDERED. STRAIN NOT TO EXCEED 6000 LBS. PER SQUARE INCH.

WORKING PRESSURE PER SQ INCH	SIZE OF STAYBOLTS.											
	5/8	11/16	3/4	13/16	7/8	15/16	1"	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16
60	4 1/16	5 1/4	5 13/16	6 5/16	6 7/8							
80	4 1/16	4 9/16	5"	5 1/2	6"							
100	3 5/8	4 1/16	4 1/2	4 15/16	5 5/16	5 3/4	6 3/16	6 5/8				
120			4 1/16	4 1/2	4 7/8	5 1/4	5 11/16	6 1/16	6 5/16	6 15/16		
140			3 13/16	4 3/16	4 1/2	4 15/16	5 1/4	5 5/8	5 7/8	6 5/16	6 11/16	7
160				3 15/16	4 3/16	4 9/16	4 7/8	5 1/4	5 1/2	5 15/16	6 1/4	6 5/8
180				3 [illegible]	4	4 5/16	4 5/8	4 15/16	5 3/16	5 5/8	5 15/16	6 1/4
200					3 13/16	4 1/4	4 5/8	4 11/16	4 15/16	5 5/16	5 5/8	5 15/16

strength of the stay-bolt; and, second, the stiffness of the material in the sheets to overcome bulging, or buckling. The United States Government allows 6,000 lbs. of strain per square inch upon any iron brace or stay, figuring the strength of the stay-bolt from the cross-sectional area at the bottom of the thread. As, for example, find the strain allowed upon a stay-bolt 1⅛ in. in diameter, 12 threads per in.; $\frac{3}{32}$ in. of the diameter is required for the thread, consequently the diameter of the stay-bolt at the bottom of the thread would be $1\frac{1}{32}$. This, expressed decimally, would be 1.0125, and $1.0125 \times 1.0125 \times .7854 \times 6,000 = 4,830.6$ strain allowed. Table No. 4 contains the diameters over the thread, diameters at the bottom of the thread, areas at the bottom of the thread, and the strain allowed on each size of stay-bolt.

Having the strain allowed, the next question is, How far can the stay-bolts be spaced or pitched apart to have—not to exceed this limit—6,000 lbs. of strain upon them? For example, find the extreme pitch of ⅞-in. stay-bolts to sustain a working pressure of 120 lbs. per square inch. Referring to Table No. 4, find the pressure allowed on a ⅞-in. stay-bolt is 2,876 lbs.; divide this quantity by the boiler pressure per square inch, 120 lbs., and the square root of the remainder equals the pitch: $2,876 \div 120 = \sqrt[2]{23.97} = 4.89 = 4\frac{7}{8}$ in. Table No. 5 gives the extreme pitch of different-sized stay-bolts for different working pressures, figured as shown above.

The second point will now be considered, viz., the extreme pitch of stay-

TABLE No. 6.

EXTREME PITCH OF STAYBOLTS, THE STIFFNESS OF THE MATERIAL COMPOSING THE SHEETS BEING CONSIDERED. U. S. GOV. RULE.

WORKING PRESSURE PER SQ. INCH	THICKNESS OF MATERIAL							
	3/16"	1/4"	5/16"	3/8"	7/16	1/2"	9/16"	5/8"
60	4 1/16	5 7/16	6 13/16	8 3/16	9 5/16			
80	3 9/16	4 15/16	5 15/16	7 1/8	8 5/16	9 1/2		
100	3 1/8	4 1/4	5 3/16	6 5/16	7 7/16	8 1/2	9 1/2	
120		3 7/8	4 15/16	5 13/16	6 3/4	7 3/4	8 11/16	9 11/16
140			4 1/4	5 3/8	6 1/4	7 1/16	8 1/16	8 15/16
160			4 3/16	5	5 7/8	6 11/16	7 1/2	8 3/8
180			3 15/16	4 3/4	5 1/2	6 5/16	7 1/4	7 7/8
200			3 3/4	4 1/2	5 1/4	6	6 3/4	7 1/2

bolts, the stiffness of the material being considered, taking into consideration the thickness of the sheet and the boiler pressure required. For example, find the extreme pitch of stay-bolts in a ⅜-in. thickness of sheet. To sustain a working pressure of 160 lbs. per square inch, the rule is: The square root of a constant number multiplied by the square of the thickness of the sheet in sixteenths of an inch, divided by the pressure per square inch, equals the pitch. This constant number is 112 for sheets $\frac{7}{16}$ of an inch or less in thickness: and 120 for all sheets of greater thickness: $\frac{3}{8} = \frac{6}{16} \times \frac{6}{16} = 36$; $112 \times 36 \div 160 = \sqrt[2]{25.2} = 5$ in., the pitch. Table No. 6 gives the pitch of stays to conform to the United States rule, as figured above.

Speaking of moving of trains under control of signals, Mr. W. L. Derr, superintendent of the Erie, a most practical railroad officer, said: "An unfailing electric track circuit is now called for in the more advanced systems of blocking, such as the controlled-manual, in which the signalman at the advance end of the block controls, through electric agency, the signals at the end of the block; and the automatic sys-

Fig. 15

tem, in which the signals are operated electrically by the passage of a train into and out of the block. Much of the trouble with the rail circuit is from grounding when the rail is in contact with certain kinds of ballast, and from imperfect work done by trackmen in making repairs. Any suggestions for the betterment of the track would be a boon to those who have these circuits to care for."

* Foreman Boiler-maker, C., M. & St. P. Ry., [illegible], Iowa.

EQUIPMENT NOTES.

The Missouri Pacific have ordered ten locomotives from Baldwins.

The Seattle, Lake Shore & Eastern have ordered one locomotive from Richmond.

The Chicago, Rock Island & Pacific have placed an order with the Peninsular Car Works for 200 cars.

The Louisville & Nashville have ordered ten consolidation and five ten-wheel locomotives from Rogers.

The Westmoreland Coal Co. have ordered 100 coal cars from the Allison Manufacturing Co., of Philadelphia.

The South Baltimore Car Works have received an order from the Baltimore & Ohio Railroad for repairing 1,300 freight cars.

The St. Charles Car Co., St. Charles, Mo., have received an order for 100 dump cars from the Mississippi River & Bonne Terre Railroad.

The Savannah, Florida & Western have ordered a locomotive to be built at Rogers, for exhibition at the Atlanta Cotton Exposition. They are reported to be asking bids for more locomotives.

The Westinghouse Machine Co. are erecting fine new works in Eastern Pittsburgh, which will greatly increase the present capacity. The shops are going to be fitted up with the best tools in the market for doing the work.

Brooks' people have received orders for five locomotives from the Chicago, Rock Island & Pacific, and seventeen from the Great Northern. The reports were that the Great Northern people were about to order 100 locomotives, but it dwindled down to the number named.

The Laconia Car Co., Laconia, N. H., have received an order for 600 cars from the Boston & Maine Railroad. The cars are to be of 60,000 pounds capacity. The order is for 200 box cars, 200 platform cars, and 200 coal cars. These cars will be equipped with Gould M. C. B. couplers and Westinghouse air brakes.

The Southern Pacific have ordered six vestibuled sleeping cars, two dining cars, four composite cars, and four compartment and parlor cars combined. Each of the composite cars will be partitioned off at one end for baggage, and the balance of the car will be used for a smoking and reading room, and will contain a barber shop and café. The cars are to be used on the Sunset Limited trains, between New Orleans and San Francisco.

The indications are that there will be a particularly full exhibition of railroad rolling stock at the Atlanta Exposition. The managers of the Exposition have made arrangements to build an annex of 35,000 square feet to the Transportation Building for the accommodation of locomotives and trains. The Southern railroads are quite enthusiastic in favor of making the display a grand success, and many of them will make large exhibits. We already hear complaints from Northern manufactuers that space is hard to get.

When Cramps' people, of Philadelphia, engaged to build two steamships that would hold the record against the finest of the British-built liners, they determined to use the best material in the market for the parts that had an important bearing on the success of the vessels. In the pursuit of this policy they ordered Ajax metal for the bearings of the two vessels, the *St. Louis* and *St. Paul*, and the enterprise has brought a gratifying reward. The *St. Louis* made a remarkably quick maiden trip and did not have trouble from a single hot bearing. This is an extraordinary record, and is something for the makers of the metal to be proud of. Over 40,000 pounds of the metal was required for the two vessels.

"Uneven Wear of Locomotive Tires" is a subject which has been very much discussed by technical societies, but an efficient remedy appears to be as difficult to find to-day as when the disorder first became familiar to railroad men. We have lately been surprised to find that on level roads, where trains are run moderately light, the tires wear more unevenly than they do on roads that are hilly and have heavy traffic. This fact would seem to sustain the point made by several of our correspondents, that running an engine habitually with a full throttle and the power graduated by the reverse lever, causes the driving-wheel tires to wear unevenly. A level road gives better opportunity for running with a full throttle, as a regular thing, than an uneven road, and so the results of the practice are likely to be more apparent on level roads. It does not, however, follow that the practice of running with a full throttle is a bad one, even if it is proven to be hard on tires. The expense of turning tires is a small item compared to the cost of fuel; and if an open throttle makes the coal do much more work, the question of uneven wear of tires cuts a small figure.

The Prussian Boiler Protective Union has been investigating whether it is necessary to apply a chemical test in order to specify exactly the quality of a boiler plate. A commission appointed to carry out exhaustive tests, and to investigate the subject thoroughly, reported that it is not advisable to specify a maximum or minimum percentage of single elements. They recommended higher values for bending and extension tests. Attention was directed to the injury to wrought iron and steel plates from working them at a blue heat. Exhaustive tests made on boiler plates that had been subjected to the ordinary working pressure for years showed that the tensile strength and elongation diminish to a great extent.

The Atlantic Coast Line has designs for a very handsome building in which to house the exhibit of that system at the Cotton States and International Exposition, at Atlanta, Ga. The railroad exhibits will be one of the great features of the fair, and will excel in extent any similar exhibits ever made.

The old and well-known firm of machinists and founders, Leland, Faulconer & Norton Co., of Detroit, Mich., has changed its name to the Leland, Faulconer Manufacturing Co., who will continue the old business on a larger scale.

Transmission of Power in Railroad Shops.

There were a number of remarkably good reports of investigating committees read and discussed at the last Master Mechanics' Convention, but one very important committee did not submit a report, and general regret was expressed at the failure. This was the Committee on Transmission of Power. It was appointed to investigate the relative merits of pneumatics and electric transmission of power in railway shops, a subject which is exciting much attention among railroad men at the present time. That is to say, compressed air and electricity as means of transmitting power are receiving more attention than any other subject, but the relative merits of the two are not in dispute. Both have their uses, and they come very little into competition. What was highly desirable in a report on this subject was the information it would disseminate concerning the great saving some railroads are now enjoying from the use of compressed air and electricity in transmitting power to tools that were formerly operated by hand and are still operated by hand in nearly all shops.

It might be supposed that information on this subject was not required, since the railroad mechanical papers have been thoroughly ventilating it for years. They have contained many articles and illustrations explaining how these labor-saving methods are employed, but the impression made on the whole has been evanescent. We are safe in saying that there are many men in charge of railroad shops who have never heard that valve-facing machines, boring mills for cylinders, the drilling and tapping of stay-bolt holes, drills and reamers for pit work, and a variety of other operations carried on about the locomotive on the pit, are operated by power transmitted through pneumatic or electric motors. The more enterprising master mechanics vie with each other in finding new operations to be worked by power transmitted in this way; but the enterprising master mechanic does not represent the majority of his class. Those who are contented to drag along with hand labor are in need of the stimulant that comes from hearing particulars of what others are doing; and a committee's report on the subject would advertise it better than anything else that could be done.

There is one phase of this subject which is badly in want of the information which free discussion brings out. Some of our best shops are using electric motors for driving some of the machine tools, and others contemplate doing away entirely with shafting and using electric motors exclusively for transmitting power to the machines. The experience with electric motors for this purpose has shown such important saving of power that the change promises to be rapid. But the new system of power transmission entails a rearrangement of the machine tools, and it is very desirable to have the teaching of experience

as to what is the most advantageous manner to arrange the tools. By a judicious arrangement one motor may be employed to drive several tools, and in other cases it is considered best to connect the motor with only one tool.

As there is not likely to be a Master Mechanics' report soon upon this subject, we should be pleased to receive the views of our readers who have experience with this system of transmitting power to machine tools.

Disputes in Interchange of Cars.

At the last meeting of the Arbitration Committee of the Master Car Builders' Association, held at Chicago, fifteen disputes between those interchanging cars which had been referred to the Arbitration Committee were decided.

The Lake Shore & Michigan Southern Railway Company rendered a bill against the Kingan Refrigerator Line for broken draft springs. Payment of the bills was refused, on the ground that these defects cannot be chargeable to ordinary wear and tear, but are results of cars or engines coming into violent contact with its cars. The railroad company held that the defects were not chargeable to ordinary wear and tear, and that it showed clearly that the springs were defective. It was also said that it renders bills against all private car owners for breakages of this kind, and such bills are recognized as being proper.

In deciding the case, the Arbitration Committee say the draft springs from reputable manufacturers can always be purchased under a guarantee of a given number of years' service. A spring manufacturer could not evade his responsibility in case a broken spring was returned to him on the score that it had received unfair usage, especially when no other damage occurred to the car. The usual way in which draft springs fail in their guarantee is by breaking. The length of service draft springs give depends largely upon the quality of steel and the care that is exercised in their manufacture. They hold that the bill was correct and ought to be paid. This is a very good point made in favor of good material.

A car belonging to the Texas & Pacific was wrecked on the line of the Fort Worth & Denver, and the latter company elected to return the trucks and air brakes to the owner. When the material was received the owners of the car complained that the floating levers, truck levers, push rods, etc., should have been included in the air-brake attachments returned.

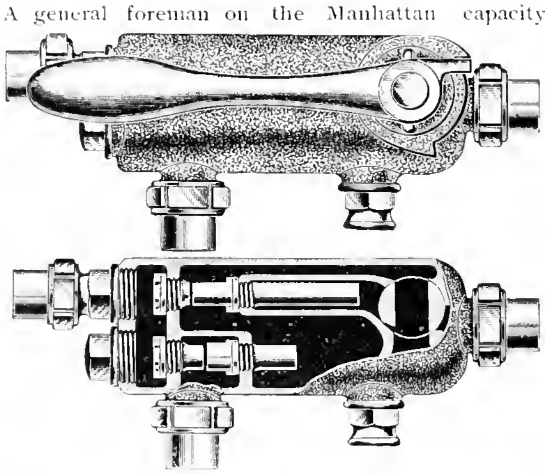
The Ft. W. & D. people held that they had returned all the material called for under the M. C. B. Rules, and no agreement being possible between the disputants, it was referred to the Arbitration Committee.

The decision was, that returning the material specified in the M. C. B. Rules was all that was necessary.

The Brownley Double Tube Injector.

We publish cuts of this new double tube valveless injector, which works at any pressure, from 15 pounds up to 350 pounds; works all the way from 350 pounds down to 6 pounds without any regulation and without breaking; and lifts and feeds water on a 3-foot lift at temperatures up to 156 degrees, and on a 22-foot lift as high as 130 degrees. These leading points we gather from certificates of thoroughly well-known and independent people, published by the agents of the Brownley injector.

The device appears to be very simple; the steam inlet is one size smaller than the suction and delivery, thus being very economical as regards steam. To start the injector, steam is given, when the water will immediately appear at the overflow; the cock is turned by means of a lever, and the water is then being fed to the boiler. No variation of steam at any point, from 350 pounds down to 6 pounds of steam, causes any loss of water at the overflow. A general foreman on the Manhattan



Railway says that he tested machine against one of the same size Standard injectors, and was somewhat surprised at result, the Brownley throwing about 33 per cent. more water in a given time than the other, and doing it for a steady diet. He also says that one of the greatest points about the injector is its great simplicity, which will be duly appreciated by those having charge of injector repairs. There are no valves to grind. Any ordinary mechanic can take machine apart and put it together in five minutes. A plant never requires to shut down on account of injector repairs.

The tendency of the age is all toward higher steam. In a few years, 300 pounds may be as common as 175 pounds is to-day. Many experiments have accordingly been made by injector manufacturers, and large sums of money have been spent to attain this object.

The injector for locomotive purposes is slightly varied in form, so as to be interchangeable with any standard injector. No jarring or application of emergency brake causes injector to break.

Circulars containing certificates from reliable and well-known users of steam will be obtained on application to Mr. R. F. Keating, 187 Cherry street, New York, the general agent in the East.

The Standard Coupler Co., No. 26 Cortlandt street, New York—Geo. A. Post, president, and A. P. Dennis, secretary—have a card in this issue, presenting the strong points of their Improved standard coupler—all in a nut-shell.

Cheapest Way to Compress Air for Shops.

A committee of the Southwestern Railway Club, appointed to find out the best means of providing compressed air for railroad shops, report that in nearly all the first attempts to supply compressed air in railway shops the Westinghouse pump has been used with results not altogether satisfactory, owing to failure to get sufficient pressure on account of low steam pressure carried on shop boilers, from small storage capacity of reservoirs and from other causes. This has had the effect of dampening the zeal of those interested; and this cause, with the fact that a cheap and reliable air compressor was difficult to get, has had much to do with delaying the introduction of compressed air as a labor-saving medium in railroad shops.

The most economical method of obtaining compressed air in railroad shops is with some strongly-built and well-designed air-compressing pump, to be driven from the line shafting by suitable belts, and to be so geared as to be of ample power for work required. These pumps or compressors should be duplex in their action, and arranged to stop and start automatically when regulator is set at required pressure. There should be in connection with the compressor, ample storage capacity, and great care should be taken to see that all joints and connections are absolutely air-tight, and all cocks, valves, etc., kept in good order.

There are several air compressors, driven by belts, now in the market. One by the Pedrick & Ayer Co., Philadelphia, has been made specially with a view of meeting the needs of railroad shops.

A Summer Note-Book

Is the title of a beautifully illustrated pamphlet issued by the passenger department of the M. C. R. R., containing a map and description of many attractive resorts in Michigan, Canada, St. Lawrence, New York and New England. It is sent on receipt of 10 cents, to cover postage, by O. W. Ruggles, General Passenger and Transportation Agent, Chicago, Ill; James S. Hall, Michigan Passenger Agent, Detroit, Mich.; or any other principal passenger office of the Michigan Central R. R. Co.

Air-Brake Department.

Announcement.

In opening a distinct Air-Brake Department, the publishers of LOCOMOTIVE ENGINEERING believe they will be adding a feature to the paper that will be appreciated. Heretofore we have published much air-brake matter, and in the future expect to publish more and better selected material.

An air-brake man of national reputation has charge of the department, and will select all the matter for it; for the present, his name will not be announced for personal reasons; later on our readers shall know who he is.

We shall put into this department all matter pertaining to air brakes, repairs, manipulations, or what not. All correspondence, and the questions and answers referring to air-brake subjects, will be placed under this head.

It is proposed to make this paper the *authority* on all air-brake questions, and our readers can rest assured that they will be fairly treated here, and the truth told in all cases. Those desiring to ask questions will have the satisfaction of knowing that the answers are correct and up to date. Right here, let us try to impress upon writers the importance of stating every particular of the case in asking questions. We solicit correspondence for this department, especially from those having kinks on repairs, etc. THE EDITORS.

An Up-to-Date Air-Brake Instruction Book.

A sample copy of the proceedings of the Second Annual Convention of the Association of Railroad Air-Brake Men comes to us fresh from the press, skillfully edited, handsomely bound, and teeming with practical information on correct practices and maintenance of air brakes. It bears evidence of deep study and intelligent research in its treatment of subjects, containing about 240 pages of instructive matter of different forms, and is replete with that practical information so much sought after by road and shop men of all classes, as well as railway officials who wish to improve the general condition and service of air brakes. This book should be in the hands of every man who handles or works upon air brakes, and who wishes to keep up to date in this progressive field.

The subjects are well handled, and the discussions which follow are sound and eminently practical. The thoroughness, harmony and unison which characterize the work of this active young association are truly commendable, yet are no more than should be expected, when it is remembered that the organization is made up of the best air-brake men from all sections of the country, who are earnestly endeavoring "to obtain a higher efficiency in air-brake service."

While being but two years old, the association has already achieved such success and wrought sufficient improvement in air-brake service to entitle it to the indorsement of the M. C. B. and M. M. associations given it at the conventions at Thousand Islands last month. We wish it a continuance of its success.

Copies of the proceedings may be obtained by writing P. M. Kilroy, secretary, Pine Bluff, Ark., who will furnish flexible leather and paper-bound, at $1.00 and 50 cents, respectively.

Tests Made to Determine the Stopping Power of Engine, Reversed, With and Without the Use of Air Brakes

We present to our readers the following interesting and instructive matter, copied from the appendix of the proceedings of the Second Annual Convention of the Association of Railroad Air-Brake Men, which is fresh from the press.

Unusual credit is due Mr. Thomas for his characteristic thoroughness and liberality in making these expensive and practical experiments.

The question has been frequently asked regarding the relative length of stop which can be made with the air brakes and the engine reversed; also, how much farther the engine will run, if reversed, when air brakes are applied and the wheels locked, than if the air brakes alone be used. There has been no reliable information to be had on this subject, and all replies to these questions have been more or less mere conjectures, from the fact that no practical tests of this nature have ever been made, so far as is known. To the intelligent interest which Mr. J. W. Thomas, Jr., assistant general manager of the N. C. & St. L. Railway at Nashville, Tenn., takes in air-brake matters, and his liberal assistance in conducting a system of experiments in this direction, the railroad public largely owes the information herewith presented.

The tests were made under the personal supervision of Mr. Thomas, and no expense was spared to make them thorough, complete and reliable. The first tests were quite unsatisfactory, owing to the very low braking power developed by the old-style cam brake with which the engine was equipped, but upon being made acquainted with this fact, Mr. Thomas promptly ordered the engine to the shop, and a modern 75 per cent. push-down cam brake be substituted for the old one, which was braking at about 30 per cent. When the tire became so badly flatted as to endanger the safety of the rail and locomotive, the engine was sent to the shop and the tire returned, that the tests might be continued and the desired data be obtained complete.

The records are numbered merely for reference, and the inference should not be drawn that only this number of stops was made, for, on the contrary, nearly one hundred runs were made, and the records given in the table are averages of this number. Six whole days were required in all to make these runs.

The committee believes the proceedings the proper medium through which this information should be disseminated, and, with Mr. Thomas' permission and the committee's thanks for same, the table on following page is submitted:

Data—Braking power on driving wheels of locomotive, 70 per cent.

Braking power on wheels of tender, 100 per cent. of light weight.

Braking power on wheels of N. C. & St. L. coaches, 90 per cent.

Braking power on wheels of Pullman sleeping cars, varied from 40 per cent. to 101 per cent.

A trip was placed in the track to open the train pipe. A second trip was used to open the signal pipe, thus giving the engineer a signal to reverse the engine simultaneously with the application of the air brakes. Engine was equipped with a Boyer speed recorder, which was tested each day.

The following order of operation was followed: First, brake applied; second, engine reversed; third, sand lever opened.

Track was level and in best possible condition.

Tests were made under the most favorable circumstances.

The deductions to be drawn from the tests may be summed up as follows:

First—The shortest reliable stops will be made by a retarding power which is most quickly developed and maintained to the highest possible limit during the entire stop, consistent with safety from skidding of wheels, such as the air brakes give, and is confirmed by records in the accompanying table.

Second—The retarding power given by the back pressure in the steam cylinders when the engine is reversed fluctuates and is too inconstant to be relied upon. As soon as the back pressure developed is greater than the adhesion between the wheel and the rail, the driving wheels will revolve backwards and lose nearly all retarding force. Trials were made throwing the reverse lever ahead a sufficient length of time to release the wheels and get them running forward again; but so much time and distance was lost in this effort that the stop exceeded in length that made by leaving the lever in the back motion after it had been placed there. The length of stop was the same, whether the cylinder cocks were opened or closed. When the engine was reversed without brakes, the wheels did not lock rigidly.

Third—The length of stop made with air brakes applied and engine reversed, while being longer and extremely injuri-

ous to the tire from skidding and making flat spots, is not as long as was expected, but is satisfactorily accounted for by the fact that as the flat spot grew during the stop, and, with the heat developed, gave a larger and better surface to the rail for adhesion. The stop was longer than those made with the brakes alone and was very costly. The results of these tests should determine the inadvisability of using the reverse lever in conjunction with air brakes.

Fourth—Sand is a good thing if judiciously used, but if used after wheels are skidding, will produce flat spots and will not unlock wheels after they commence sliding. A superabundance of sand is not quite so effective as a moderate amount. The best results were had from a rail upon which sand remained from previous stop. Upon a rail thoroughly "saturated," but not burdened with sand, it was impossible to slide the wheels under the conditions which prevailed. On straight track, if sand reached the rail before full retarding power was developed by the air brake and the back pressure in the steam cylinders with engine reversed, wheels would not lock nor slide; but on curves where engine rolled about, the adhesion between the wheel and rail, even when increased by a free flow of sand, would be broken, and the drivers would lock and slide with disastrous results. Several of the "Unexpected Emergencies," as recorded in Nos. 29 and 31, were made on curves, but the majority were made on straight track. If sand valves were opened before brakes were applied and engine reversed, the wheels would not lock in "Expected Emergencies," but the delay in applying retarding power would slightly lengthen the stop over that had by the use of the air brakes alone.

Fifth—In making the "Unexpected Emergency" stops, the drivers would invariably lock when engine was reversed, and flat spots were had. In one instance the engineer, who was unusually expert and active, got tangled up with the reverse lever, and did not succeed in reversing the engine with his first effort. The train ran considerably farther than the length of stop given in No. 29. The time consumed by the engineer in applying brakes, reversing engine and opening sand valves was $1\frac{1}{2}$ seconds, which is very much quicker than the feat can be accomplished ordinarily. When also considering the fact that a certain length of time is consumed by the engineer recovering from the bewilderment of unexpected emergencies, it would seem impossible for him to get sand on the rail before the wheels would lock, if he were to reverse his engine after applying the brake. The "Expected Emergency" given in No. 30 was a good stop, but engineers seldom meet expected emergencies.

Sixth—The Pullman cars were not braking as they should, as the piston travel on all cars varied from 10 to 12 inches. After the slack was taken up, better stops were had. The percentage of braking power on these cars had an abnormally wide range. The condition of the brake apparatus upon the N. C. & St. L. coaches, which were taken from service without any preparation for the test, speaks eloquently for the system of maintenance of brakes on the N. C. & St. L. Ry. Tests Nos. 32 and 33 were made by backing the car with the engine until the desired speed was developed; then the angle cock was closed, engine detached and hose uncoupled. The angle cock was opened at a certain point, from which the stop was taken. A comparison of the stops made by the sleeper and the coach will, perhaps, cause a surprise to some readers, and perhaps open up a new line of investigation, which, if followed up, will reduce the number of slid flat wheels had on coaches.

Number.	Brakes Used.	Condition of Train.	Speed.	Sand.	Total Number of Stops Made.	Maximum Length of Stops.	Minimum Length of Stops.	Average Stop in Feet.	Time in Seconds.	Wheels Slid.	Flat Spots.
1	Driver and tender brakes	Engine and tender	30	No.	9	260	240	254	11	No.	No.
2	Driver brake alone	" " "	30	"	2	438	387	412	18	"	"
3	Tender brake alone	" " "	30	"	7	604	458	538	23	"	"
4	No brakes, engine reversed	" " "	30	"	3	494	420	450	20	Locked and revolved backwards.	"
5	Driver and tender brakes and engine reversed	" " "	30	"	4	290	245	270	12	Yes.	$2\frac{1}{8}$ in.
6	No brakes and engine "plugged"	" " "	30	"	2	540	505	522	25	Locked and revolved backwards.	No.
7	Driver and tender brakes	" " "	30	Abundance.	1	260	260	260	11	No.	"
8	No brakes and engine reversed	" " "	30	"	1	285	280	284	12	"	"
9	No brakes and engine "plugged"	" " "	30	"	1	265	265	265	11	"	"
10	Driver and tender brakes and engine reversed	" " "	30	No fresh sand.	4	177	140	158	9	"	"
11	Driver and tender brakes, with engine "plugged"	" " "	30	"	1	177	177	177	9	"	"
12	Driver and tender brakes	" " "	20	No.	1	111	111	111	8	"	"
13	No brakes and engine reversed	" " "	20	"	1	161	161	161	9	"	"
14	Driver and tender brakes	" " "	20	Yes.	1	90	90	90	6	"	"
15	Driver and tender brakes	" " "	40	No.	1	532	532	532	25	"	"
16	No brakes, engine reversed	" " "	40	"	2	861	820	840	32	Locked and revolved backwards.	"
17	Driver and tender brakes	" " "	40	Yes	1	475	475	475	20	No.	"
18	All brakes cut in	Engine, tend & 5 N C & St L coaches.	30	No.	8	271	240	258	11	"	"
19	All brakes cut in	" " " " "	30	Yes.	1	250	250	250	11	"	"
20	All brakes cut in and engine reversed	" " " " "	30	"	7	335	100	265	11	Yes.	3 in.
21	All brakes cut in	" " " " "	40	No.	4	500	400	474	12	No.	No.
22	All brakes cut in	" " " " "	40	Abundance.	1	475	475	475	19	"	"
23	All brakes cut in and engine reversed	" " " " "	40	Yes.	1	542	542	542	23	Yes.	4 in.
24	All brakes cut in	Engine, tender, 5 N. C. & St. L. coaches and 4 Pullmans.	30	No.	1	327	327	327	14	No.	No.
25	All brakes cut in	" " "	35	"	1	465	465	465	19	"	"
26	All brakes cut in	" " "	40	"	2	575	575	575	25	"	"
27	All brakes cut in	Engine, tender & 4 Pullman sleepers.	30	"	1	307	307	307	14	"	"
28	All brakes cut in	" " " " "	40	"	1	762	762	762	20	"	"
29	*All brakes cut in and engine reversed	Engine, tender and 5 N. C. coaches.	30	Yes.	9	375	218	350	13	Yes.	$2\frac{3}{4}$ in.
30	†All brakes cut in and engine reversed	" " " " "	30	"	1	325	325	325	13	No.	No.
31	†All brakes cut in and engine reversed	" " " " "	30	"	1	375	275	275	14	Yes.	3 in.
32	Pullman sleeper (kicked)		30	No.	1	416	416	416	18	No.	No.
33	N. C. & St. L. coach (kicked)		30	"	1	202	202	202	17	"	"

* Unexpected Emergencies. † Expected Emergency.

Have you any kinks, tools or jigs for saving work on air-pump repairs? Locomotive Engineering wants all the *new* ones and all the good ones—and is willing to pay for them.

The soft hammer should never be used on the fireman's head—treat the air pump the same way.

W. W. Knight's Automatic Brake Valve.

Editors:

I submit you herewith a blueprint and explanation of an improved engineer's brake valve of my invention, which I would like inserted in LOCOMOTIVE ENGINEERING, believing it would be interesting to your readers, whose free criticism I invite.

There are three important automatic features embodied in this design:

First. Automatic in maintaining excess pressure (while in running position) through the main supply valve 2, obtained by constructing the valve so that 70 pounds on the top of piston valve 2 and 70 in train line will seat valve, and require 90 pounds to raise it, thus securing an excess pressure of 20 pounds. The spring is just sufficient to overcome any friction of packing and seat the valve.

Second. Automatic in retaining 50 pounds in main line, regardless of the application made by the engineer. This is accomplished by piston 1 (Fig. 2). Main reservoir pressure is admitted at all times through port *B* to the small end of piston 1 and on top of rotary valve *K*. The large end of piston 1 is exposed to train-line pressure, and the proportions of differential piston 1 are such that 50 pounds on the big end will equal 90 pounds on the small end, so when train-pipe pressure is reduced to anything below 50 pounds, piston 1 travels toward the large end, uncovering port *V*, admitting main-reservoir pressure to the top of equalizing piston 3, thus automatically stopping any further reduction in train-pipe pressure.

Third. Automatic in closing main supply valve 2, thus maintaining main reservoir pressure while in running position, in case of a hose bursting or conductor applying brake.

By making a tracing of rotary valves, Fig. 3, and placing it on the seat, same side up as shown, the ports and cavities of rotary valve *K* and seat *M* can be easily read.

Release Position 1.—Cavity *S* in valve, Fig. 3, in this position exhausts air from the space above piston 2, through ports *L* and *J*, thus allowing piston 2 to raise and charge train pipe. Port *N* supplies cavity *R* with main-reservoir pressure at all times. In this position port *N* will supply port *G*, thus securely seating equalizing discharge piston 3. As the train-pipe pressure rises above 50 pounds, piston 1 travels to position shown in Fig. 2, thus supplying train-line pressure through ports *A* and *C*, through cavity *T* in valve, through port *E* to small reservoir.

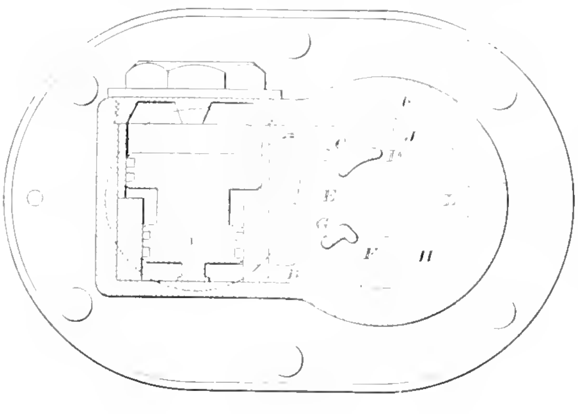


Fig. 2

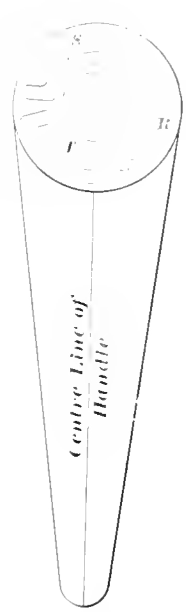


Fig. 3

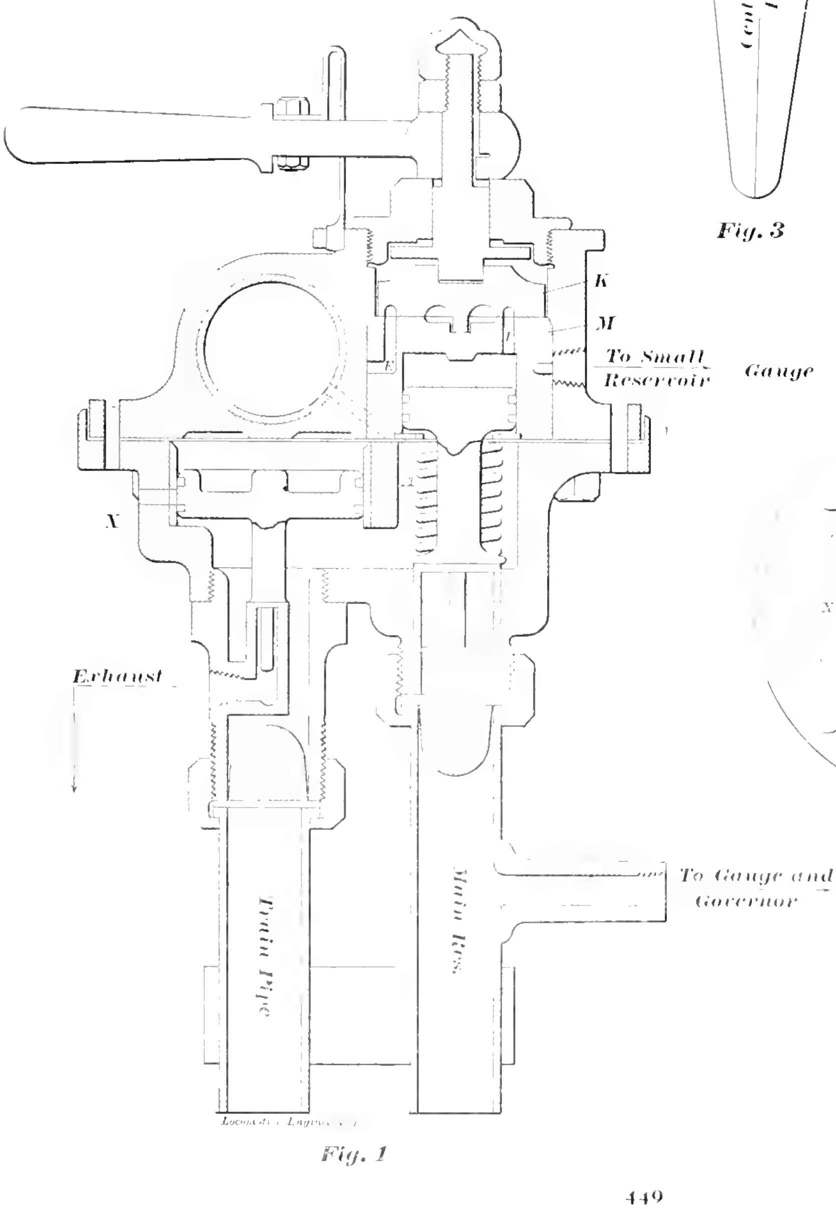


Fig. 1

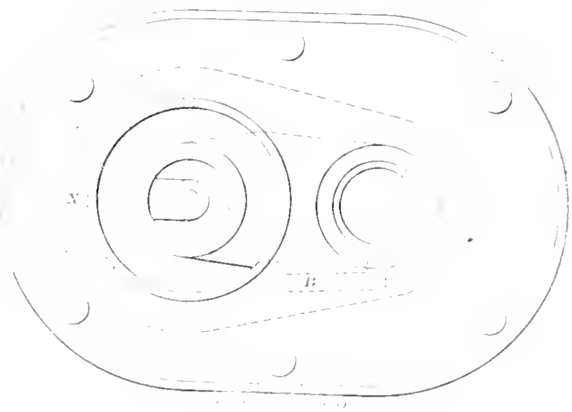


Fig. 4

Running Piston 2.—Placing handle at running position, port *N* ceases to supply port *G*, but cavity *T* is substituted, and train-line pressure is brought from ports *A* and *C* to port *G* to top of piston 3 and port *E*. Cavity to small reservoir *P* in seat connects cavities *T* and *S*, supplying the cavity above piston 2 through port *L*, and obtaining excess pressure. If, in this posi-

tion, a hose would burst, or any accident would reduce the train-line pressure, piston 1 would travel the opposite direction from that shown in Fig. 2, thus uncovering port *V*, and admitting main-reservoir pressure to top of piston 3, thence up through port *C* and cavities *T*, *D* and *S* and port *L* to the top of piston 2, thus securely seating pistons 2 and 3, and automatically saving any waste of main-reservoir pressure.

Lap Position 3.—On lap blanks all ports; port *N* through cavity *R* delivers main reservoir pressure on top of piston 2, securely seating same.

Service Application 4.—In this position cavity *T* connects ports *E*, *G* and *F*. As *E* and *G* are connected together, any preliminary exhaust through port *F* gives the desired equalizing discharge, as port *F* extends half-way round seat in bushing *M* and communicates with the small reservoir. If handle is held in this position till train-line pressure is reduced to 50 pounds, piston 1 travels in the opposite direction, as shown in Fig. 2, thus automatically restricting any further reduction in train pipe.

Emergency Application 5.—The handle being placed in this position, port *N*, cavity *R* and port *L* continue to supply main-reservoir pressure to the top of piston 2, as in lap and service application positions. Cavity *T* connects ports *G*, *F* and *H*. As the little reservoir is cut out it doesn't require a second for the air to escape from the top of piston 3, thus allowing piston 3 to travel its limit, uncovering a row of holes *X*, and giving a sudden reduction in train line until 50 pounds in train line allows piston 1 to again perform as in a service application, thus automatically maintaining a train-pipe reserve, which otherwise would be wasted.

Please note the bearing on rotary valve; there is no bearing for 1¼ inches in the center, thus wearing the valve and seat without rocking. W. W. KNIGHT.

Memphis, Tenn.

[While this device is constructed on the same lines and principles as the Westinghouse engineer's valve, whose prime features it appropriates for a basis upon which to build, it shows that considerable credit for labor and study is due Mr. Knight in working out the novel features which it contains. However, it does not seem that his production is quite equal to the valve he aims to improve upon. Necessity, and not imitation, is the mother of invention. Like many untried mechanisms, it would probably not stand the test of practical service so well as it shows upon paper. It is true that defects which would develop could be corrected, but, judging from mechanical history, these corrections would bring it into a closer proximity to the valve now in use. This fact is noticeable in all new air-brake systems; they originate in novel form, but, in attaining higher perfection, gradually assume form and appropriate functional parts of valves they seek to improve upon, until halted by patent litigation.

As the excess pressure carried by roads in different sections of country varies from 15 to 40 pounds, specially constructed differential pistons (No. 2) would be required for long and short trains, and mountainous and level roads.

While the practice of economy in use of air pressure is desirable, it can hardly be indorsed when carried to this extreme, which restricts the engineer to two-sevenths of his pressure in both service and emergency applications, as it does in this device, and renders his brakes inoperative by sealing up available pressure after a reduction to 50 pounds has been made. Should the pressure by any means be reduced to 50 pounds, that remaining hoarded up in the train pipe ceases to be of use as a stopping power, and would be beyond the engineer's reach were either a service or an emergency stop demanded.

If seven forward-motion notches were cut in the reverse-lever quadrant of a locomotive, and a stop pin so placed through the quadrant as to restrict the engineer to the use of the two notches nearest the center, it would be very economical, but from a practical standpoint the scheme would be quite top-heavy and decidedly unpopular.

We believe there is entirely too much stress laid upon saving of air pressure; some instructors going so far as to recommend a return of brake-valve handle to lap after making an emergency application. The emergency position was designed to make quickest and shortest possible stops, and this last resort and safety feature should not be thus dangerously restricted or handicapped by improper instruction or interception of any mechanical device in the emergency port. A $10,000 wreck costs more than one dollar's worth of repair parts.

Equalizing piston 3 is weak in mechanical design, inasmuch as that a metal packing ring cannot be made sufficiently tight to hold a high pressure when atmospheric pressure is on the other side. Leather packing would burn out from boiler heat.]

Foundation Brakes.

Editors:

Mr. Haskell's able article on the above subject, in the June number of LOCOMOTIVE ENGINEERING, calls to my mind some thoughts which may be of interest.

Referring to some fast fruit trains between Texas and Chicago, he says: "If proper braking power is wanted anywhere, it is wanted on these trains; and with the load they carry, a uniform power of 70 per cent. of light weight brings the actual braking power down to a figure that is, I think, rather low for the speed they run." That is putting the case very mildly. The same statement applies to many other kinds of service with equal or greater force, and serves to bring up again the question which the writer has so often raised, as to whether it would not be advisable to use a higher percentage of braking power on freight cars. In spite of strenuous opposition, we have persistently advocated this for some time past. For a time we stood alone, but things are looking brighter for this one of our pet hobbies. As we once heard "Doc" remark, "Surely the world do move." Perhaps that part of it which is engaged in pursuits connected with the air brake will some day come to the point where it will discover that the great fetich known as 70 per cent. is no longer to be worshipped, as of yore, and when 80 or perhaps 85 will receive some recognition.

There is no other part of the air brake problem which, at the present day, is deserving of so much attention as the foundation brake, and all who have the good of the service at heart will be very much gratified to see that much more is being said about it in the pages of our papers.

Another point considered in Mr. Haskell's paper is as to the utility of two hand brakes on each car. In this connection, the element of safety should be given more consideration than has been customarily accorded it. It is not an infrequent occurrence for a hand brake to become disabled through breakage of the chain or some similar happening, and then, if an attempt be made to switch the car on a grade, it cannot be held. The writer remembers a number of more or less exciting experiences due to a single car getting loose on a grade, jumping the switch and starting out on a journey down the main track. With two hand brakes, there is always one to fall back on in case of emergency, and the extra cost is, after all, not very great. On many cars, it is to be noted, there are two hand brakes, but each one affecting only one end of the car. That is not good practice. If one becomes disabled, only half the braking force is available, besides which, it is necessary, in all cases where full braking force is desired, to set both brakes, involving a loss of time. As is stated in the paper referred to, it is not necessary, where two hand brakes are used, that they should be on opposite sides of the car. The point is to get one at each end.

Attention might also be called to the fact that a number of automatic slack adjusters are coming into use. The need is so great that this is inevitable, and it certainly would be the part of wisdom to provide for it in correcting the abuses in the foundation brakes. The great enemy of the automatic slack adjuster is, and has been, the abnormal amount of give or spring that exists in most forms of brake rigging. No adjuster, no matter how perfect, can be made to discriminate between slack due to wear and that which results from stretching of rods, springing of beams, etc. The only way to get satisfactory results from a slack adjuster, is to do away with the spring and leave the mechanism only the wear to compensate for.

If a device is developed which will

brake a car in proportion to the weight it carries, then we shall encounter a need not met before, *i. e.*, a brake rigging which will stand a strain about three times as heavy as that at present met with. Such an improvement will, in all probability, compel the use of a larger cylinder for a given size of car. It would be well, perhaps, to keep this in mind. The advantages which would be derived from such an improvement would more than compensate for a pretty extensive outlay.

PAUL SYNNESTVEDT.

Chicago, Ill.

Ward Defends Conger and Disagrees with Plunkett.

Editors:

The contention of J. J. Plunkett, in April issue is, it seems to me, but a renewal of the thread-worn subject, viz.: Whether there is, or not, communication between his gage and train line when brake valve is on lap. On this point I think there is no disagreement among the air-brake doctors. It may be that they are all wrong; that the Westinghouse Co. has been engaged in constructing an equalizing brake valve with a leakage or equalizing groove around piston 17, when the very object of that piston is to completely and effectually separate the space above the piston from the space below, for upon this complete separation depends the desirable and satisfactory features of the equalizing discharge valve. The movements of piston 17 are automatic, being operated and controlled by the unequal pressures above and below.

Establish communication between the space above piston and train line below, and the result would be an equalization of pressure, and piston 17 would at all times remain in normal position, and there could be reduction of train-line pressure only through preliminary exhaust port, and, in emergency, through direct application and exhaust port. Then, in service application, the pressure being reduced alike, and through the same opening, the equalizing piston would be cut out and rendered inoperative. Such would be the result, it seems to me, if Mr. Plunkett's theory is right. He would not, perhaps, contend that there was sufficient opening around piston 17 to accomplish such results; but if the black hand registers at all times train-line pressure, then the opening must be large enough to do just this and nothing more.

Suppose, Mr. P., that you lap the valve, and there is a slight leak from equalizing reservoir, or around the gasket between body of valve, do you think you would get a movement of piston 17, and an application of brakes? If so, then the pressure above must be less than the pressure below piston 17, and the pressures have failed to equalize through the opening which you imagine to exist. The principle upon which the equalizing discharge valve is designed and constructed, demands that piston 17 should be air-tight, just as much as piston 4 in triple valve, or piston in brake cylinder; and if it is as designed, then the black hand has no communication with train line when the brake valve is on lap, and Mr. Conger was right.

A question for some of the boys. The air-brake doctors tell us that it requires a reduction of 20 pounds from train line to set brakes in full; that with a reduction of from 5 to 8 pounds from train line, if there be a broken graduating valve, or a weak graduating spring, you will get an emergency application on the car with defective triple, and full application on balance of train. How do you account for this?

J. B. WARD.

Rochester, N. Y.

Agrees with Conger, and Gives Some Good Advice to Correspondents Sending Air-Brake Problems.

Editors:

I have been quite an interested reader of the air-brake problems published in LOCOMOTIVE ENGINEERING. I think the correspondents would do the readers a great favor if they would make a better distinction in the brake valves and other parts they are explaining.

For instance, in a problem on brake valves, say D 8 or D 5, or if a triple valve, give class of same, and give size of brake cylinder and auxiliary reservoir.

C. B. Conger is right in answer to question in March number, when he states black pointer on gage will not indicate pressure in train pipe, and demonstrates it by exhausting the air from train pipe by means of the angle cock, with brake valve on lap.

J. J. Plunkett must know that black pointer indicates train-pipe pressure only through the medium of chamber D above equalizing piston.

W. T. Hamar's problem has not been solved to my satisfaction. I think cause was some other place, because it takes a rather sudden discharge of air from train pipe to start triple piston past feed port in piston cylinder, and quite a feed from auxiliary reservoir to push brake piston by leakage groove in brake cylinder. Coupled as Hamar's cars were, I think that any ordinary leak in auxiliary will be equalized by pressure feeding back through feed port of triple in the other car. I think it is always best to examine into all the particulars at the time of the occurrence; then the difficulty is not always so hard to solve.

GEO. DOUGLAS.

Chicago, Ill.

[Correspondents cannot be too careful to obtain all data and circumstances which influence or have bearing on the problems submitted. Explanations and answers must always accompany puzzles, else they will not be published.—ED.]

Preventing Flat Wheels by a Double Application.

Editors:

Mr. J. R. Alexander, in an article in the June number of LOCOMOTIVE ENGINEERING, mentions the fact that, following the report of the Committeee on Slid Flat Wheels, at the St. Louis meeting of the air brakemen, a discussion was started on the advisability of instructing engineers to use a double application in making service stops on a very bad rail, in order to prevent the sliding of wheels.

As it was the writer who introduced the resolution which led to the discussion referred to, and, as we are still of the opinion that the recommendation, as drawn, was a good one, in spite of the fact that, with but one exception, we were voted down unanimously, we desire to say something further on the subject.

The recommendation was intended to apply to passenger trains only, which are seldom of very great length, and always, or almost always, well coupled. Under such conditions, there is very little liability of breaking a train in two by the practice. It is perfectly obvious that on long trains such a practice would be objectionable, and, in fact, on such trains it would be found impracticable, because a quick release of all the brakes, or what is called a partial release, cannot be made with any certainty at all. On short trains, however, it can be done without trouble. Anyone, who will take the pains to try the experiment, will find that with 20 pounds excess pressure (train line 70) and a train of, say, six cars, after any service application of less than about 15 pounds reduction, it is practically impossible to move the engineer's valve handle around to release position and back to lap with sufficient rapidity to prevent all the brakes from releasing. The writer has tried it many times, and has many times seen others try it, and he does not remember a single instance when all the brakes did not release; the trial being made, of course, with brakes in good average condition.

After such a release, to prevent the brakes from coming off entirely, it is necessary to immediately follow it by another service reduction, sufficiently heavy to reverse the motion of the triple valve, before all the air in the brake cylinders has had time to escape.

No question can be raised as to the correctness of Mr. Alexander's recommendation that the first reduction should be made heavier than it commonly is, so as to get the benefit of greater braking force at the higher speed; but it will be found in practice that this will very often result, unavoidably, in just what the writer is advocating, *i. e.*, a double application; for it is a very difficult thing for an engineer to judge all the conditions with a sufficient degree of accuracy to permit him to stop just where he desires, without, after such an application, making a quick or partial release. The couple of pounds which he

would feel safe in using, in addition to the first heavy reduction, is not sufficient leeway to provide for making accurate stops, and as he does not want to take chances of running past, if he uses that kind of application, he generally makes his reduction such as will stop him a little too soon. In conclusion, it may very pertinently be said that the double application on bad rail and short train, as a preventative of flat wheels, has been tried by many engineers in practice of the most exacting kind with excellent results, and without any difficulty from breaking of trains.

It is to be distinctly understood that this practice is not considered best under ordinary conditions, but is offered as a special permission to meet a special case. It was argued at the meeting above referred to, that the grant of such permission would be detrimental, because, without any discrimination, the engineers would be apt to use the same method under all conditions, and that it would detract from the force of the doctrine that stops should be made with a single application. We deny the correctness of this reasoning, but, on the contrary, incline to the belief that the effect of such special permission would be just the opposite; that it would tend to call attention to the fact that, under all *ordinary* conditions, the *single* application should be used. The exception would emphasize the rule. PAUL SYNNESTVEDT.

Chicago, Ill.

The Sweeney Brake Re-Patented in Chile.

We are in receipt of a letter from a prominent railroad official at Valparaiso, Chile, calling attention to the description of the Sweeney attachment to the S. P. engine described in our March issue, and stating that the identical device was patented in Chile in January of this year by Mr. Frank Sharp, running shed foreman of the Antofagasta road, and sold to the Government for $10,000—lucky Sharp!

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(1) J. G., Jackson, Tenn., asks:

In making a service stop, and bringing the handle back on running position, what makes the air escape out of exhaust fitting till you bring it back in full release? *A.*—The train pipe charging up faster than chamber D and small reservoir. Notice that blow is longer with light engine, short train, and with heavy excess, and that it does not occur with long train and light excess.

(2) F. E. M., Salem, N. Y., desires information on proper lubricant for the air cylinder of the pump. *A.*—We would discourage the use of tallow and low-grade oils. A good quality of West Virginia ground oil is particularly adapted to this work, as it possesses the lubricating and at the same time cleansing qualities needed for the air cylinder. Lubricants should never be used in the air cylinder to the extent which affects the valves and hose of the air-brake system.

(3) W. G. W., Baraboo, Wis., asks:

1. Which will stop in the shortest distance, a long train or a short one, say five cars or twenty, with the same percentage of brake power and under same conditions? Some of our old-time brakemen claim the long train will stop in the shortest distance after the brake is fully applied; if so, please state why. It is expected that the engine is braked the same as the train. *A.*—With precisely same conditions governing both trains they should stop in about the same distance, there being a hair-splitting difference in favor of the short train, because it takes longer to apply all brakes on a long train. After all brakes are applied, the holding power is the same on both long and short trains.

(4) J. S. B., Covington, Ky., writes:

In your answer to W. H. Z. (64), page 304 of May number, you say a reduction of air passage to drum will cause pump to ram up more air than there is steam pressure to drive it. Please state between what two points this reduction of the air passage must be made to produce this effect. *A.*—This answer was not sufficiently full; we should have added that the higher air pressure was momentary, and existed only in the air cylinder and discharge pipe to the reduced passageway. Any Westinghouse air pump, in first-class condition, will create more pressure in main reservoir than steam pressure required to drive it, because the area of steam piston is greater than that of air piston. Boiler feed pumps are made on this same principle.

(5) F. S. McK., Creswell, Colo., writes:

Not being connected in any way with locomotives, I am at a loss to know why, in operating the Sweeney emergency brake on the heavy twelve-wheeled Schenectady Central Pacific locomotive, described in the March (this year) number of LOCOMOTIVE ENGINEERING, it is necessary to reverse the engine in order to have the cylinders pump air into the main air reservoir. Will you kindly explain? *A.*—Engines equipped with the Sweeney device use the Westinghouse pump for compressing air, as usual; but should emergency demand it, both steam cylinders may be converted into compressors, also, by reversing the engine. Properly speaking, the Sweeney device is not a brake, but an emergency pump or compressor.

(6) L. W. T., Nashua, N. H., writes:

In May number of LOCOMOTIVE ENGINEERING, A. B. P. asks: Is there any difference between direct application of air brake and emergency? Our answer is: Correctly speaking, there is no manipulation of the air brake known as direct application. With everything in good order, it would appear to me that there was service and emergency application. Now, if you were to break your brake-valve reservoir, or pipe leading to it, you would plug up train-pipe exhaust, put a blind gasket between brake valve and brake-valve reservoir, and when you made an application it would be direct. There would be three applications—service, emergency and direct. Am I right or not? *A.*—There are but two regular applications, viz., service or indirect, and emergency or direct.

For several years past, two committees of the Master Car Builders' Association have been investigating the best material for brake shoes. One committee has been devoting its attention to road tests of various brake shoes, and the other to laboratory tests. In both cases, fourteen different kinds of shoes were tested, a soft cast-iron shoe made by the Pennsylvania Railroad Co., at Altoona, forming a medium of compression for all the other shoes. Among those tried were hard cast-iron shoes, soft open-hearth steel, hard open-hearth steel, malleable iron, pressed wrought iron and a variety of other specialties. Their intelligent reports were submitted by both committees to last convention. The investigations do not seem to have been favorable to the special forms of brake shoes in use. A sentence in one of the reports seems to tell the whole story of both committees. It says: "In analyzing the results, it will be observed that the prevailing practice in the United States in the matter of brake shoes for freight service, namely, that of cast iron, is, generally speaking, not far from the best yet known." The report also says that "great variations in the retarding power of passenger and freight car brakes may result in service from the lack of uniformity in the friction furnished by the great variety of brake shoes used, notwithstanding the fact that the brake gear in all other respects may be adapted to giving the best results. Much time has been devoted to the development of air brakes and brake gear that will operate successfully within reasonable limitations, and it would seem that while certain standards have either been suggested or adopted by the association, covering brakes, it would be entirely proper to extend limitations to brake shoes as well."

Don't forget to make a liberal allowance for finishing any pieces of steel to specified dimensions. Many costly dies and cutters are spoiled by neglect of this important matter, which generally results in dies having soft spots in them, and cutters having teeth not hard enough to do good work. There is no economy in this. Better order the steel a little larger. So says the Crescent Steel Co.

From a statement showing the locomotive performance of the Ohio River & Charleston, we find that the average coal consumption for all the engines was 9.77 pounds for passenger service, 9.61 pounds for mixed trains and 7.34 pounds for freight. A general average of 40 miles to the ton of coal was made. Mr. W. J. Wilcox is master mechanic of the road.

This office is headquarters for air-brake information. Send in your orders for any book published on brakes, and we will get it for you.

No air-brake man should be without Conger's latest book on brakes. It is the best for examination purposes. Price 25 cents.

To insure answers in the next issue of the paper, brake questions must be in this office by the 15th.

Longitudinal Stays or Braces Through Boiler Flues.

Editors :

In looking over Mr. Connor's letter as above, it made me refer to Mr. Dawson's in April number, but failed to see where he claimed to be the originator of flue-sheet braces, but simply said he had used them in 1893. For your information would say that nearly all the engines on the L. & N. W. Ry., England, have these braces running through boiler; they were first used about ten or fifteen years ago, and were put in engines (four in each one) as they went through shops for repairs, and were found to have the desired effect, namely, to stiffen flue sheets. We put them in engines with flues in good shape, and they had a tendency to keep them tight much longer than engines running without them. Yours truly,

Boone, Ia. H. L. BENTLEY,
R'house F'man, C. & N. W. Ry. Co.

A Waste Picker for Box Packing.

Editors :

I send you a sketch of waste picker used for picking the waste apart for packing journal boxes on cars and engines. This was designed by L. T. Canfield, general foreman of the shops of the C., R. I. & P. at this place. It does very good work, and the result obtained from preparing the waste in this way is very encouraging, as the cost of oiling cars has been reduced from 18 cents per 1,000 miles to 9 cents per 1,000 miles, and hot boxes cannot be traced to a car that has been packed with the waste prepared in this way, thus reducing the number of hot boxes to almost zero. The machine is intended to run about 1,200 per minute, and the cylinder used on the machine was made out of an iron pulley; but where this is not to be had, one made out of wood, will answer, strips of babbitt or lead put in around the pins, will support the pins and give weight to the rim of the cylinder; it should be balanced perfect if run at a high rate of speed.

The casing is made of galvanized iron of 16 or 18 gage.

The concave, or stationary pins, are 6½ inches long, made of ½-inch round steel. The cylinder teeth are 1½ inches long.

The frame is made of 4 x 4-inch oak.

Waste is fed in at top, and comes out at bottom, finely picked to pieces, and oil still saturating it

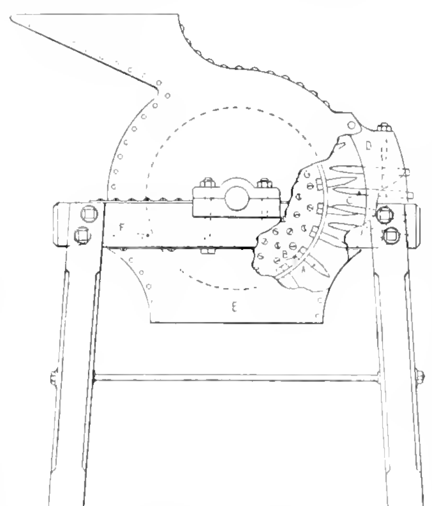
All cars on this road are packed every six months. I will say here that in repicking boxes it is not very often that the waste removed requires any additional oil. Just remove waste and put it through this machine, and replace it.

Davenport, Ia. A. G. RAMSEY.

Changes Needed.

Editors :

You don't want to print any more communications under *nom de plume*, for you say that a man should have the courage to put his name to an opinion of his, or a complaint. Now, this is all right in a way; but suppose that an engineer, or a railroad man of any sort, wishes to give his road a cut for some injustice done, or some tyrannical official in their employ, etc. If



WASTE PICKER.

he writes to you and signs his name, the letter, through your columns, may reach the eyes of his superiors, and call down their wrath upon his unlucky head. But by your iron clad rule he must risk this or else keep quiet. Now, you are differently placed, and are in the ownership of your own paper and under obligations to none for your living; you can cut and lash right and left, as I am happy to see that you do; but in the case of the railroader it is different.

Why cannot the Westinghouse Brake Co. make their air pumps with the steam cylinder down? It looks as if, by so doing, that there would be less likelihood of water getting into the air cylinder.

Either yourself or a correspondent says the best braking is done by braking by the gage. How about many of our large engines, where things are so crowded and so badly arranged that in daytime, even, the engineer has to light a match and crawl up onto the top of the boiler in order to see either steam or air gage; mind, now, I believe that the above opinion is all right, but how about carrying it out in practice. I think that the air gage should be placed down on the front of the cab on a level with the engineer's eye, or as near it as possible; then the engineer can brake with one eye on the gage and the other on the track; this is on locomotives where the boiler runs through the cab. Again, why not place the brake valve on such engines, like the B. & O. places them on their flyers that haul the "Royal Blue," that is in front of the engineer, at about the height of his knee, so that he won't need to reach half a mile back of him on the boiler to get a grip on the brake-valve handle.

Which form of side rod is, in your opinion, the best—the girder section or the fish-belly form? The latter is used by the C. R.R. of N. J. on many of their fast passenger engines.

How is it that you often give pictures in your paper of great wrecks, smash-ups, etc., but never a word as to when they occurred or on what road? For instance, "The Results of a Late Order," "Engineer Forgot his Orders," etc. It is slightly exasperating to see such views without a word concerning them.

You gave the American locomotive whistle a dig in one of your late issues. God bless the locomotive whistle, with its strong, full note, that drives the healthy into profanity and the sick into their graves. Long may she wave!

WILLIAM B. RAINSFORD.

[If we permitted all the men, who are ready to tell wholesome truths about their superiors, to air their grievances in these columns, we would have no room for anything else.

We consider the I section rod the strongest.

If we gave particulars of where wrecks happened, we would not get many photographs.—EDS.]

Those Queer Locomotives.

Editors :

In your issue for May, I notice a letter from a Sheffield (England) correspondent, which is a surprise to me. His remarks concerning the locomotives in question are, to a certain extent, correct; what his object is, in mentioning one trifling altera-

tion when so many had to be made, I fail to see.

Both freight and passenger engines were badly designed, but Messrs. Sharp, Stewart & Co. were not responsible; the workmanship and finish are seldom equaled, even on the other side, where such things still continue to be done by skilled workmen—not laborers. Mr. W. H. Cooper was superintendent; Mr. E. H. Heinke, assistant superintendent; Mr. H. B. Clive, leading erector. Mr. Cooper's son, W. E. Cooper, only just out of his apprenticeship, took no leading part in the work until near the close of the contract. I remember Mr. Hinchliffe as a fellow worker with, and companion of, Cooper, Jr. My desire to see justice done to those who were really in charge of this important work, is the only reason I have for replying to Mr. Hinchliffe.

W. H. COOPER.

Philadelphia, Pa.

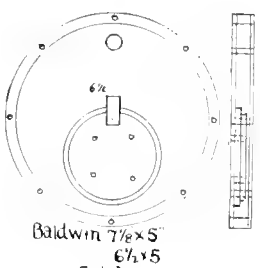


FIG I

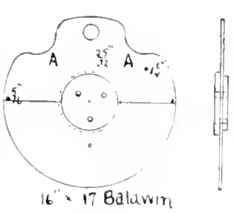


FIG.2

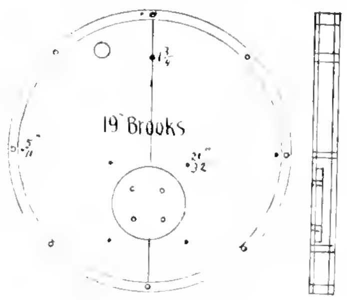


FIG 3

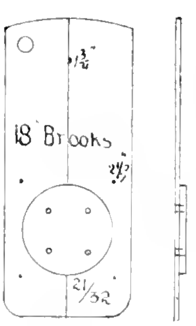


FIG 4

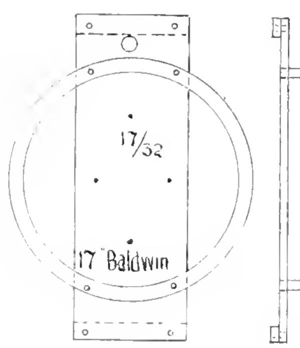


FIG 5

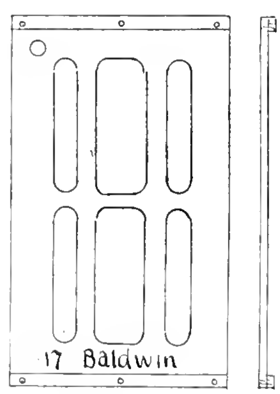


FIG.6

Templates.

Editors:

Templates are and should be regarded as tools as much as taps and reamers, but how many shops are there that have a set of templates for even the work that comes to be laid out the most? I judge not many; for of all the men that have been hired here—and they come from a great many shops and from all sections of the country—it is the exception to have one ask for the template to lay out back cylinder heads or any other part, but they will either get the old head up on the bench (if there is enough remaining), or they will get the new one on the floor alongside of the old one, and then, with hammer, center punch, dividers and rule, get down on their knees on the floor with them, and proceed to lay out the new one from the old. Now, if the old one was right and the workman is first-class, it will come out all right in the course of one-half to three-quarters of an hour.

In locomotive works, I believe that they lay out all their work from steel templates that are hardened. To get up such a set is a luxury that cannot be thought of in a shop where there is a half-dozen or more different makes of engines, and two or more different sizes of the same make. But all shops ought to have some, and the more the better.

The following are some that we have. They are made of stack steel.

Fig. 1 is for laying out the key slot in eccentrics. The plate is of stack steel, to which, around the outside, is riveted a band of ¼ x ¾-inch iron. To one side of the center the amount of throw is riveted to plates. There could be more if there were more different-sized axles with the same throw. The rim is bored out to go on the outside of eccentric, and the plates are turned off to fit the hole. It is not necessary to have too good a fit. Then lay out exactly on center line the keyway; they will, when laid out with this template, always come alike. Try it. Fig. 2 is for a back cylinder head as are also Figs. 3 and 4.

On Fig. 2 there is a plate riveted on each side to fit different-sized stuffing boxes, and as Baldwin guides are all the same distance apart, this can be done with this one. The way we use this is: After the holes have been drilled that bolt the head to the cylinder (for which we also have a template), the head is ground, then held on with two bolts, and a straight edge laid across the frame, and a line drawn across the face. It will come so as to be seen where the template is cut away, *A*, Fig. 2. Put the template so as the center line will be parallel with this, and then mark all holes. Figs. 3 and 4 are templates. Where the engines have Laird guides, these heads are all drilled before they are taken to the engines at all, and a center line put on them that is squared from the frames. Fig. 5 is for laying out the disk of an American balance valve, also the valve. The plate is the width of the valve, with strips riveted on each end, exact length of valve. On the other side a ring is riveted that fits over disk.

Fig. 6 is for false valve seats; it has strips riveted on each end, to just fit over so as to hold it in position. If balance valves had come into general use twenty years sooner, this is a template that would would not have had to be made. I might tell the length of time and mileage that one of our engines in fast passenger service has made without facing, but you would in all probability want to put it in the Liars' Corner. She has made 200,000 miles, and, at the rate she has worn, is good for as many more.

These templates, with dozens of others, are easily made; and if care is taken in laying them out, work will always come the same. The holes on the templates are $\frac{1}{16}$-in. But the best of templates are useless if they are not plainly marked what they are for, and at all places where there are to be holes drilled, the sizes should be stamped on. There is more scrap steel thrown away than would make these, and need not be old, either; and more time saved in laying out work, the expense of which would more than pay to buy new material to make them of.

W. A. ROBERTSON.

Cedar Rapids, Ia.

A Good Oil Record.

On the D., S. S. & A. they climb some hills and use pretty fair-sized engines—19 x 24 in. for freight, 18 x 24 in. for passenger—it's a cold country, too. The average oil record there is first-class, probably a better one than could be made in a warm, dry, dusty country. For the month of April their freight engines made the following mileage for oil:

129.62	miles to a pint of	valve oil
42.59	" " "	engine oil
29.23	" " "	lubricating oil
23.45	" " "	all kinds of oil

In passenger service they made:

225.16	miles to a pint of	valve oil
43.32	" " "	engine oil
32.10	" " "	lubricating oil
27.10	" " "	all kinds of oil

The Southern Pacific people are working their repair shops night and day, getting the rolling stock ready for the pressure of business they expect to handle in the fall. Over 2,000 men are at work in the shops. This has already had an excellent effect on the business of the Pacific Coast, as other lines of work have been stimulated by the confidence created by the railroad company.

CAR DEPARTMENT

Conducted by Orville H. Reynolds, M. E.

Some Shop Kinks.

The present is essentially an age of kinks; the devices for cheapening the cost of the output of a shop are as numerous as the leaves of Vallambrosa, wherever that is, and the success or failure of many an enterprise has been measured by the ability of those at the head to devise the little schemes (yclept kinks) to save time, and therefore increase the earning power of a plant.

It is not always the fellow, though, with the gold-rimmed glasses, sitting in the office, and taking a pull at the helm betimes, who is entitled to the credit for the booming of an idea which, if carried into execution, may stave off that 10 per cent. cut. Down in the shop among the boys, battling with problems in metal, is where the brow is seen corrugated to some purpose over difficult jobs, and the handling of them heralds the birth of more kinks.

Much work that is assembled without making the acquaintance of a tool, where every surface, both interior and exterior, is technically in the rough, and which it is necessary to have as square and true as possible, must be handled by jigs and gages, in order to demonstrate their fitness for service, for a square would be just about as effective as if applied to a sphere.

The journal box and key for a passenger-car truck are two good examples to illustrate the care such work ought to have, but do not get in all places; for too many people are lax on these points, to the serious detriment of the service, thinking that because the box is cast from a pattern made on correct lines, that it will come out of the sand a perfect whole, losing sight of the factors of shrinkage, rapping and shifting of the cores, all of which are too likely to be present, and without the application of gages will remain undiscovered.

The devices shown herewith were gotten up by Mr. P. McCallum, the braw Scot, who is machine shop foreman at Como shops, St. Paul, and whose wheel-circumference indicator was shown in these columns not long since.

Fig. 1 shows in detail a gage to determine the relation between the rear flanges of box and the shoulder for key on inside of box. It is readily seen that, knowing the proper relation of these parts, an application of the gage will show at once whether the box is right or wrong at these most vital points. The frame or body is made of 1-inch angles, spread to a width of 4 inches over all, by three 1/8 x 1-inch strips riveted at ends and center.

Riveted to outside face of each angle is an arm 2⅜ inches long between shoulders, and having at the ends a swiveling block, through which passes the 3/16-inch steel

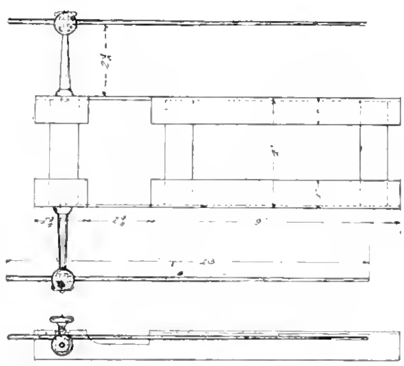


Fig. 1

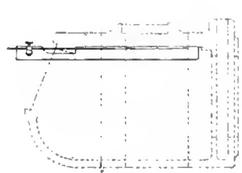


Fig. 2

gage rods. The heads are caused to be rigid by the milled nuts at end of arms, and the rods are adjustable by means of the milled screws. Fig. 2 shows its application to a box.

What this little affair will do for the box, the gages in Fig. 3 will do for the journal-bearing key.

At *A* is shown a side elevation of the gage, which is used both to lay out all dimensions to be machined on the new key, and also to determine the amount of wear on the brass clip riveted to key. This wear is found by means of the three adjustable screws shown at end views.

When a new key is to be laid off, the gage is applied to under face of key, whose rear end abuts against the shoulder on gage, first removing the slot-headed cone from its position at center of gage.

Scribing through this hole, and also those at the end for the clip, locates them accurately. On the top of key is there laid the piece shown at *B*, its jaw engaging with the lug on rear of *A*; the function of this part of the gage is to locate the shoulder on outer end of key at *C*. The whole device is shown in position on a key in Fig. 4.

There appears to be little room for improvement in these kinks.

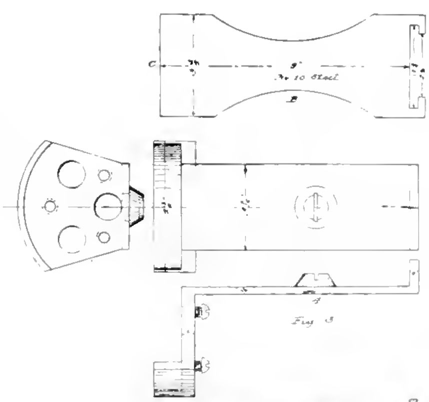


Fig. 3

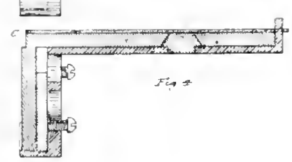


Fig. 4

Furniture Car, Northern Pacific Railway.

The tendency to increase of size and capacity of box cars, especially furniture cars, has produced some mammoths that, when loaded at their marked rate, are paying factors in the transportation problem.

Height and width having reached their limit, but one other avenue is open for a further extension of capacity, and that is an increase in length. There is no doubt that the end is near for this dimension.

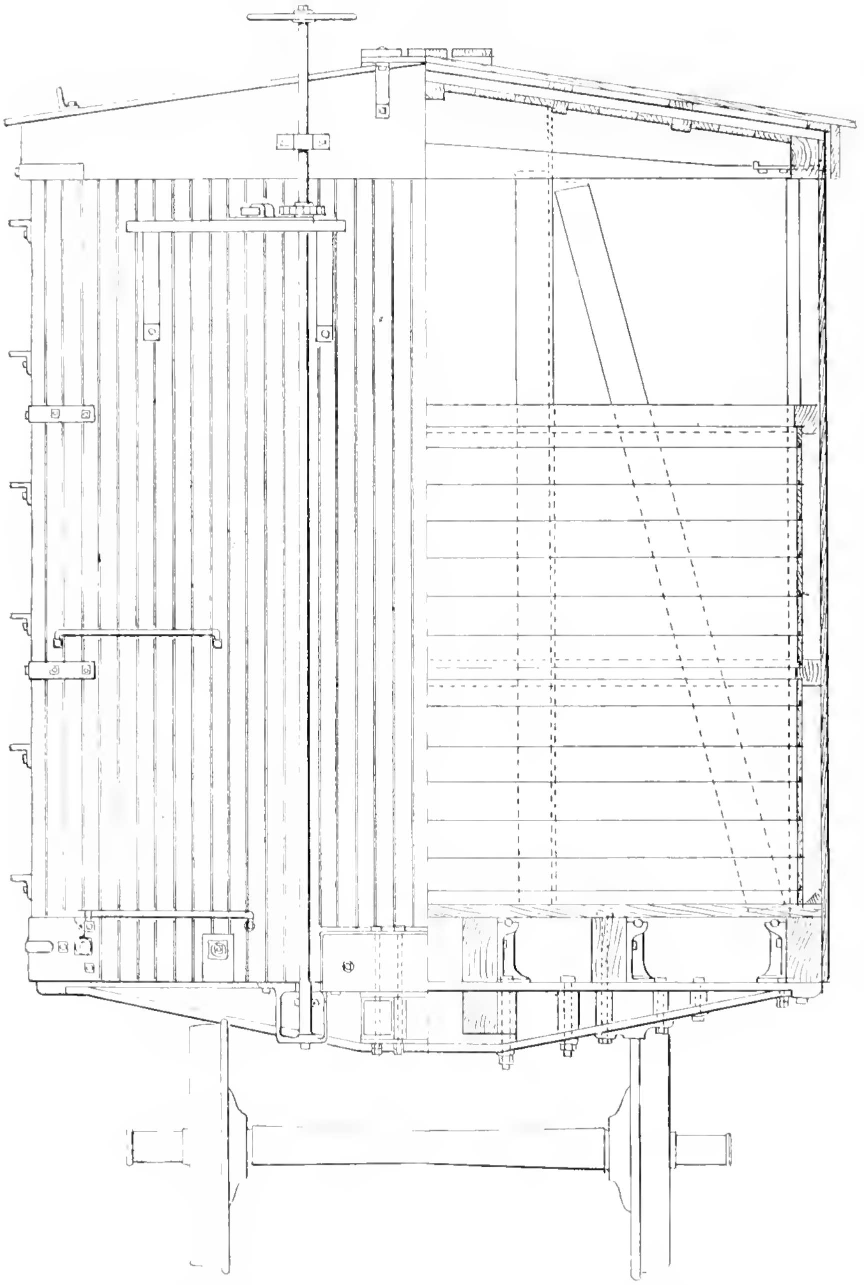
There are no wide departures from familiar practice in any of the later designs of these big commerce builders—indeed, it is not plain that any startling variations from well-established lines are possible, when considering the ratio of dead weight per unit of paying load, at least with the present wooden construction. The same old,

well-known members are in their usual places in all of them, and this will probably continue until the all-steel car is an entity. If the spirit of prophecy were on us, we should say that the time is not far away when the steel car will be no novelty.

The car presented herewith was designed by Mr. John Hickey, Supt. M. P., M. and R. S., by whose courtesy we are permitted to illustrate it. It will be found to have all the up-to-date features pos-

$2\frac{1}{4}$ in., door posts, $4\frac{1}{2}$ x $4\frac{1}{2}$ in., braces, 5 x $2\frac{1}{4}$ in.; side plates, $3\frac{3}{4}$ x 6 in.; end plates, $2\frac{7}{8}$ x 13 in.; carlines, $1\frac{3}{4}$ x 7 in.

An innovation may be seen in the introduction of bridging blocks, 3 x 9 in.; four of these between needle beams and two between needle beams and brake hanger blocks, tying the outside and intermediate sills into which they are tenoned, and the whole secured by one $\frac{5}{8}$-inch rod at each block.



sessed by the best cars of its type. The general dimensions are: Length outside of end sills, 42 ft.; width outside of side sills, 9 ft.; height from top of sills to under side of plate, 8 ft. 5 in.; length inside, 41 ft. $5\frac{7}{8}$ in.; width inside, 8 ft. $5\frac{7}{8}$ in.; cubic feet under carlines, 3,000; capacity, 60,000 pounds.

All longitudinal sills are $4\frac{1}{4}$ x 9 in., and end sills, 6 x 9 in.; needle beams, $4\frac{1}{2}$ x 10 in., draft timbers, $4\frac{1}{4}$ x $8\frac{3}{4}$ in.; corner posts, 4 x $4\frac{1}{2}$ in.; intermediate posts, 5 x

This construction gives the under framing the requisite lateral stiffness in the simplest way possible, and prevents the body from describing sinusoids usually made when cars of this length are not properly stayed. Two girths perform the same office for the superstructure, instead of lining the inside from floor to plate.

Corner bands are on the outside at plates, girths and sills, and on the inside at plates and girths. The side door openings are 8 ft. $3\frac{1}{4}$ in. x 5 ft. 6 in. There are no end doors.

The inside roof on these cars is somewhat different from usual practice; the carlines are fitted so as to leave their top faces $\frac{11}{16}$ in. below top of side and end plates, and the roofing $\frac{11}{16}$ in. thick extends lengthwise of car, flush with top of plates; the end plates being rabbeted $\frac{11}{16}$ x 1 in. to receive the roofing.

The carlines are also gained for the ridge pole and purlines so as to leave the latter flush with roofing. The whole is surmounted by the usual iron roof and its single board covering.

The running boards formed of three pieces, making a width of 18 in., extend 6 in. beyond fascia, and are supported by two wrought-iron brackets $\frac{1}{4}$ x 2 in.

All carlines are secured to plates by $\frac{5}{8}$-inch strap bolts, and end plates are stayed by a $\frac{5}{8}$-inch diagonal rod extending from ridge pole, giving the necessary stability to the roof and upper work.

The posts over body bolsters have a light cast-iron pocket at top and bottom, as have also the side and end braces. All other posts are tenoned only, and each have a $\frac{5}{8}$-inch rod through plate and sill. Two diagonal rods, $\frac{3}{4}$-inch diameter, extend from plate to sill each side of body bolster, to take care of the overhang, and they always have something to do on cars having center of draft below bottom line of sills.

Each draft timber is secured to under side of center and end sills by six $\frac{7}{8}$-inch bolts, two of which pass through the cast-iron draft timber keys.

The standard buffing plates on these cars are a long stride in advance of the old makeshifts that were put on the face of buffer block, only to be punched out of shape down into its backing.

A piece of wrought iron, $\frac{7}{8}$ x 5 in., is fitted between the buffer block and draft timbers, the latter being rabbeted to receive it, the four buffer-block bolts passing through it, making a neat and strong combination. All buffing shocks are received on the edge of this piece and transmitted to the shoulder on draft timbers at back edge.

The buffing lug on coupler taking the impact near its junction with the body of coupler, is not harmed, and is prevented at the same time from visiting its spleen on the face of the buffer block, which can now laugh to scorn the wildest moods of the boss switchman.

The draft gear is of the M. C. B. type, of course, fitted with Butler attachments—contrary to usual practice with large cars of this class, they are not lowered, the standard distance from sill to rail being maintained; the light character of the body framing keeping the center of gravity quite low, as will be evident from a study of the elevations. It will also be seen that the constant aim of the designer has been to keep dead weight within the lowest possible limit; lightness combined with

strength showing in every line from plates to sills.

After bracing for necessary stiffness, reliance is placed wholly in the six $1\frac{1}{8}$-inch truss rods, with $1\frac{3}{8}$-inch ends, to carry the load. Six rods were used in order to distribute the stresses over a greater area of end sills, rather than have them concentrated, as would be the case with a less number of rods of greater diameter. The sinking of truss-rod washers into the end sills is largely obviated by this course.

The doors are not shown in the elevations, the special details giving all needed information as to construction and hanging, together with the trimmings and their application. A grain door of special dimensions is used, as would be inferred from the grain-lines shown well up on the inside lining.

The Westinghouse automatic brake and steel brake beams are in evidence, not on the drawings, but on the finished product. Few things have been omitted in the appointments of these cars to make them stand as complete representatives of advanced practice in construction of large freight equipment.

The illustrations will furnish interesting material for those tracing the evolution of box cars, from 28, 30, 34, 36, 38 and 40 ft. up to the 42-foot car of to-day.

Air Lifts.

In the short time that compressed air has been harnessed to do duty as a prime mover, it would seem hardly credible that so many channels could be found for a paying use of it; yet, notwithstanding its multiplicity of applications, new openings are constantly being found for it, to save muscle and cheapen the handling of work.

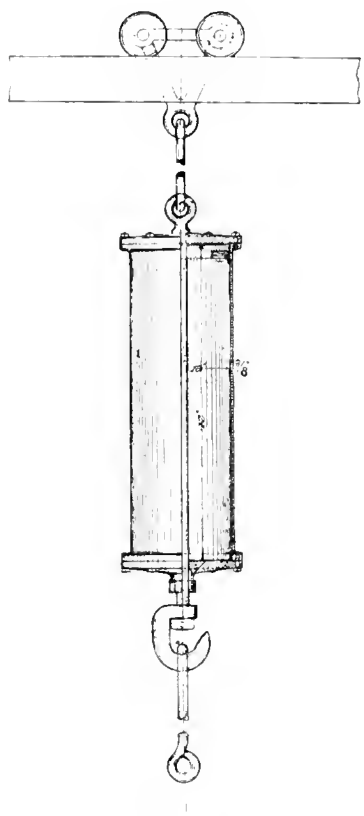
The air hoist is a case directly in point, having probably been elaborated on fully as much as any other of the numerous devices for robbing labor of some of its back-breaking terrors, and this by reason of the extremely low cost necessary to place in commission one of the most valuable adjuncts of a shop.

Capable of the widest application, it is not wonderful that its growth has been a rapid one, when it is recalled that our simian ancestors had one strong point, that of imitation, which faculty has come down to us unimpaired and brightened by long service. This may explain why a good thing is seized upon by the shop man and rushed to prominence with a hot pace, when there are points worth copying—and may, perhaps, have some bearing on the universal adoption of air for lifting work, more especially at machine tools, displacing the "muscles like iron bands," or the differential pulley block, with its snail-like movement.

They are in evidence in every shop having any pretensions to a brainy administration of affairs, and present a pleasing contrast to the old-time methods, in which a gang of laborers were in constant demand to handle the heavier work about the shop. There are few of us who cannot remember many long waits, because the "gang" was occupied elsewhere; and when they reached our job at last, it was a battle royal between gravity force and human endurance.

Now how changed! The business-like little air cylinder, hanging above a machine tool and at other convenient points, is always ready to put a job into place, and with an energy that never fails, if the compressor is running.

An air cylinder hanging to a trolley, which is fitted to run on a suitable track placed overhead, in situations requiring frequent heavy lifts, should be a favorable combination, and a very elastic one; for with it and a proper length of air hose for short distances, the lift is evoluted into a



traveling crane. A check valve makes this arrangement perfectly safe if it is thought best to detach the hose for longer distances of travel, as when the lift is used to transfer work the length of the shop.

The Northern Pacific shops at St. Paul, Minn., have a pair of these air lifts in the truck shop, to handle the truck frames and other heavy work, that are among the best we have seen.

In order to square up the truck pedestals, it is necessary to lift the frames clear of the boxes and wheels, and turn them on their backs; this has been done by hydraulic jacks in the absence of a better method, when Mr. John Hickey, superintendent of motive power, M. & R. S., introduced the lifts illustrated.

They were designed to hang from a four-wheeled carriage or trolley, rolling on a track overhead, which is supported by the 12 x 14-inch floor timbers, the track being well braced at intermediate points to prevent lateral movement, and running full width of the shop from door to door. The two cylinders are 13 inches in diameter and the pistons have a travel of 42 inches.

With an air pressure of 80 pounds per square inch, minus 15 per cent. for friction, the capacity of each cylinder is 9,024 pounds. The weight of a six-wheeled truck frame and attachments is 8,600 pounds. These figures would show the lifts stronger than requirements call for to do their work, but the contingency of a lower air pressure is provided for in this excess of capacity. As is well known, there are times when enormous calls for air are made in a yard, when testing of brakes is under way; therefore, with a drop of pressure as low as 40 pounds per square inch, these lifts are still ready for business.

There is a round wrought-iron trunnion, $1\frac{1}{2}$ inches diameter, with a $\frac{3}{4}$ x 6-inch square end, secured to each end sill of truck frame, and from these trunnions connection is made to the pistons of the lifts. When ready to lift the frame, the tie straps of the truck are dropped and the air hose coupled to air supply, which is arranged so as to be easily accessible. When the frame is high enough to clear the wheels, it is revolved in a vertical plane, thus inverting it; the wheels are then rolled out of the way, and the frame is dropped on wooden horses of a height which makes it convenient for the men.

There are three running through the shop, only one of which is provided with air lifts; but the record made by these is such that the trolley tracks will, in the near future, be continued to cover all three tracks, so that the lifts can be run to any part of the shop at will. It is intended to accomplish this by making the overhead track continuous, in the form of a letter S.

The necessity for this move has been apparent so often, that the fiat has gone forth, and the drawing illustrated is the result. When finished in accordance therewith, the heavy portions of a truck can be taken to or from any part of the shop, and that, too, at a remarkably low cost for such an efficient plant.

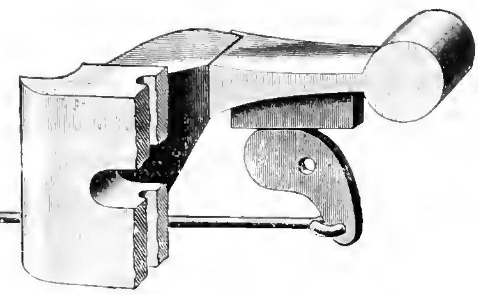
The Lone Star Coupler.

The cuts below represent the Lone Star coupler, which, perhaps, attracted more favorable comment than any other coupler exhibited at the M. C. B. Convention at Alexandria Bay. For this reason, we have thought a description of the device in detail would be of interest to our readers.

The seat of the locking device being a circular socket, taken in connection with the construction of the guard-arm, forms an arch combination, by means of which any strain brought to bear upon the guard-

arm is resisted in all directions; thus affording the greatest strength possible without any unnecessary increase of material. For the reasons stated, the guard-arm of this bar is, perhaps, the strongest yet devised, and in the tests at the works of the American Steel Casting Company, of Alliance, O., this principle has been fully verified, there having been no failures in the guard-arm.

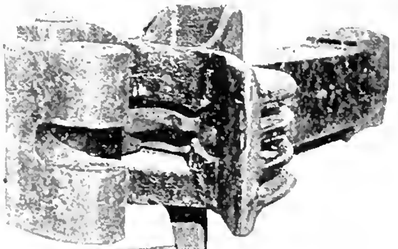
Fig 2 represents the locking device de-



tached from the drawhead, with the latch resting against the tail of the knuckle.

It will be seen that the locking device is simply a gravity latch, pivoted in a circular socket against the base of the guard-arm and resting transversely in the drawhead, thus giving a direct transmission of pressure in such a way as to be not only positive in its action but practically indestructible, as has been demonstrated by a pulling test of 181,000 lbs., without the slightest displacement or distortion of the parts.

This gravity latch is placed in operation by the movement of a cam, by means of which the knuckle is released, not only with rapidity, but with such ease as to require but little exertion, thereby enabling the separating of cars while under tension, thus affording the greatest facility in



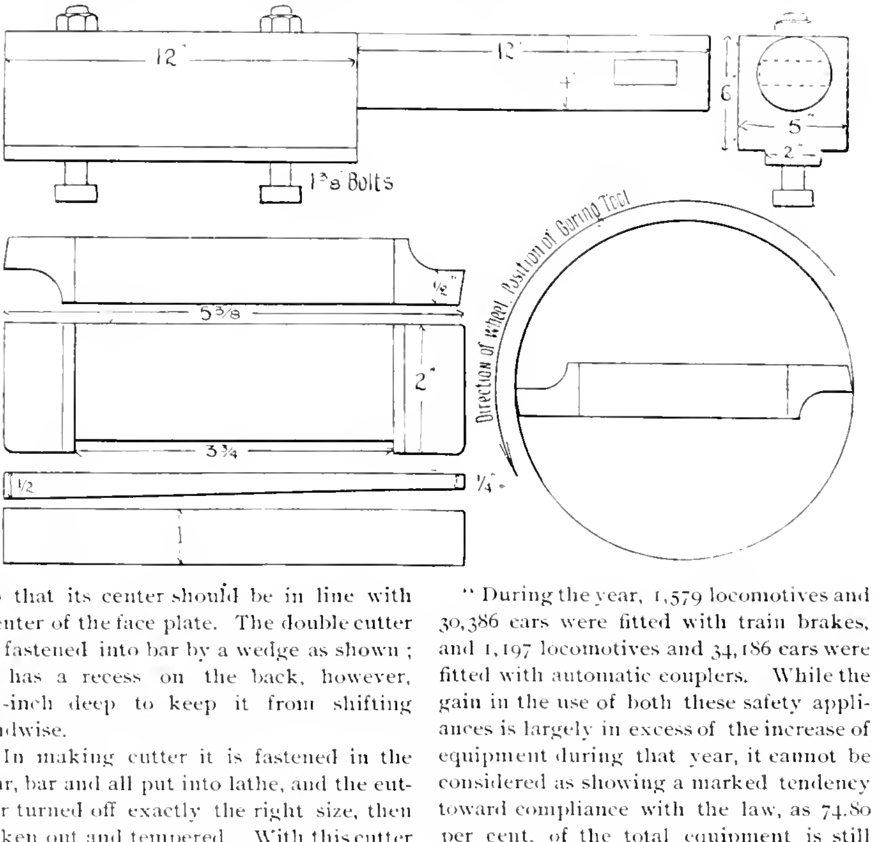
marshaling and assorting trains at terminals, as well as providing an expeditious method of detaching cars while in motion, should emergencies arise, whereby such action should become necessary for the protection of life or property.

The value of this feature is apparent in the switching of cars on gravity tracks, where the separation must be accomplished while trains are in motion, or else be attended with the loss of time incident to checking or taking stock. On Southern roads, serious losses from fires in exposed cotton, while in transit, might in a great many instances be mitigated through the expeditious means of separation afforded by this device.

By reference to Fig. No. 1, it will be noticed that the position of the locking device is such as to preclude the possibility of any interference by foreign substances or obstruction from snow and ice. The office of the Lone Star Coupler Co. is at Houston, Tex.

Neat Boring Bar for Lathe.

On the D., L. & N. road at Ionia, Mich., they had a lot of 42-inch coach wheels to rebore to $5\frac{3}{8}$. These were too large to go on boring mill, so it was necessary to bore them on the wheel lathe. With a common tool it took an hour to bore one wheel. This was too slow for Acting Master Mechanic Rupert, so he devised the boring bar shown herewith. The bar was made strong enough to stand the severe work expected of it. It was arranged to bolt on to tool post as shown,



so that its center should be in line with center of the face plate. The double cutter is fastened into bar by a wedge as shown; it has a recess on the back, however, ⅛-inch deep to keep it from shifting endwise.

In making cutter it is fastened in the bar, bar and all put into lathe, and the cutter turned off exactly the right size, then taken out and tempered. With this cutter the wheels were bored in 20 minutes each.

Railroad Rolling Stock in the United States.

The report of the Interstate Commission for 1894 says:

"On June 30, 1894, the total number of locomotives was 35,492, an increase during the year of 704. Of these, 9,893 were passenger locomotives; 26,000 were freight locomotives; 5,086 were switching locomotives, and 513 were unclassified.

"The total number of cars reported was 1,278,078. Of these, 33,018 were in passenger service; 1,205,169 were in freight service; and 39,891 were caboose, derrick, gravel, officers', pay, and other cars in the company's service. These figures do not include cars owned by shippers or private individuals. The increase in the number of cars during the year was 4,132, as against an increase of 58,854 during the previous year. This falling-off in the ratio of increase is due to the fact that the railways have during the year destroyed a large number of old, worn-out cars.

"The number of passengers carried per passenger locomotive was 62,639, and the passenger miles per passenger locomotive were 1,444,400. The number of tons carried per freight locomotive was 31,909, and the ton miles per freight locomotive were 4,016,755. With the exception of the item of passengers carried, these figures show a decrease in the efficiency of locomotives. The number of passenger cars per 1,000,000 passengers was 53, and the number of freight cars per 1,000,000 tons of freight was 1,888.

"During the year, 1,579 locomotives and 30,386 cars were fitted with train brakes, and 1,197 locomotives and 34,186 cars were fitted with automatic couplers. While the gain in the use of both these safety appliances is largely in excess of the increase of equipment during that year, it cannot be considered as showing a marked tendency toward compliance with the law, as 74.80 per cent. of the total equipment is still without train brakes and 72.77 per cent. without automatic couplers. The law requires that all equipment shall be supplied with these safety appliances before January, 1898, while it requires that all cars shall be provided with grab-irons or handholds and drawbars of a standard height by July 1, 1895."

The latest candidate for favor as a means of keeping boilers free from incrustation is called "We-fu-go." The water purifying is done by a special process and chemical reagents. Very glowing claims are made for the success achieved in cleaning fouled boilers and in preventing the formation of scale. The well-known switch and frog manufacturer, Mr. Fred C. Weir, of Cincinnati, is president of the company, which would indicate that it is something good.

Convention Notes

Alexandria Bay, N.Y.

THE EXHIBITS.

Mr. A. King represented S. Vessot & Co., of Joliette, Can.

Frederick Brandes, of Rondout, N. Y., exhibited a grinder.

Jas. McGee, of Houston, Tex., exhibited an improved beamless brake.

Mr. W. J. Cooke represented the McGuire grain door, of Chicago.

Mr. E. E. Matthews, of Syracuse, N. Y., exhibited the Dey time register.

The Rand Drill Co., of New York, exhibited one of their air compressors.

The Park coupler, from Montpelier, Vt., was exhibited by Mr. W. A. Stowell.

The Morris Box Lid Co., Pittsburgh, had an exhibit with the A. French Spring Co.

Pero Automatic Car Oiler Co., of New York, were represented by John D. Sheldon.

The Bundy Mfg. Co., of Binghamton, N. Y., were represented by Mr. A. E. Bundy.

Edward C. Bates was in charge of the Crosby Steam Gage Co.'s exhibit at Alexandria Bay.

The Standard Steel Works were represented at Alexandria Bay Convention by T. J. Lewis.

Mr. A. L. Whipple, Jr., of Boston, was among the supply men who attended the convention.

B. F. Tilden Co., Chicago, represented by B. F. Tilden, displayed frogs, car replacers, etc.

A drop door car, the invention of J. E. Simons, of McKees Rocks, Pa., was among the exhibits.

W. W. Hayward had a display in the tent of Butler drawbar attachment, made in Cleveland.

The Coale Muffler & Safety Valve Co., of New York, were represented by Mr. J. M. Fuller.

The American Steel Castings Co. were represented at Alexandria Bay by Mr. W. A. Blanchard.

J. H. Radford and Col. Lanphere represented the Otto Flohr patent coupler, made in Buffalo, N. Y.

Edward Cliff and Geo. P. Sloan, Jr., represented the National R. R. Spring Co., of Oswego, N. Y.

An automatic eccentric crosshead and wrist-pin oiler was exhibited by J. R. Drozeski, Erie, Pa.

The Columbian Metallic Rod Packing Co. were represented at the convention by Mr. Geo. O. Wilson.

The Knitted Mattress Co., Canton Junction, Mass., displayed their products in charge of F. Sumner.

F. A. Barbey & Co., of Boston and Lakeport, N. H., had a practical display of their flexible joint coupling.

Mr. Chas. H. Taylor, vice-president of the Smillie Coupler Co., was in charge of that company's exhibit.

New York Coupler Co. had one of their couplers at the convention, and were represented by John La Burt.

A good-sized model of the Ohio Injector Co. was displayed by Frank W. Furry, general agent at Chicago.

M. A. Garrett, of F. W. Bird & Son, East Walpole, Mass., had a display of Neponset roofing at the convention.

A. F. Conklin attended the convention in the interests of the New York Belting & Packing Co., New York.

H. L. Leach, of Boston, Mass., exhibited his sanding device, which is being used now by a great many roads.

Krupp steel tires and wheels were, as usual, well represented by Thos. Prosser & Son and their representatives.

O. Flohr's car coupler, made in Buffalo, was represented by J. H. Bradford, who had a full size sample to show.

The Torpedo injector, made by New England Machine Co., of Boston, was represented by Mr. J. D. Mack.

Oswego Tool Co., of Oswego, N. Y., displayed their special tools, through their representative, Mr. C. C. Place.

The Adams bolt cutter was displayed by Mr. T. M. Brown, of the Detrick & Harvey Machine Co., of Baltimore, Md.

The H. W. Johns Mfg. Co., of New York, gave away handsome souvenirs to their friends at the conventions.

The Westinghouse Air Brake Co., of Pittsburgh, were represented by Messrs. Parke, Evans, Bailey and Nellis.

L. Sennett "Auto." hose coupler was represented by Mr. O. G. Temple, of Russell, Ky., with a working model.

W. D. Sawyer represented the Massachusetts Mohair Plush Co., car and furniture plush, from 89 Franklin street, Boston.

Connecting Bar Coupler Co., Des Moines, Iowa, exhibit consisted of full size model of coupler, in charge of C. S. Grinstead.

The A. French Spring Co., of Pittsburgh, Pa., were represented at the June convention by D. C. Noble and George W. Morris.

A section of steel-tired wheels made by the Taylor Iron & Steel Co. was shown by Mr. J. H. Sheldon, of High Bridge, N. J.

Wm. Verdon, of Fort Plain, N. Y., exhibited an improved double hose band for which was claimed many points of excellence.

C. P. Krauth, the genial secretary of the McConway & Torley Co., of Pittsburgh, greeted his many railroad friends at the convention.

The Standard steel door hangers, made by Messrs. M. E. Kanaly, of Cambridgeport, Mass., were displayed by Mr. A. L. Whipple, Jr.

The Peerless Rubber Mfg. Co., of New York, made a fine display of their hose and rubber specialties, and were well represented.

The Oswego Tool Co., of Oswego, N. Y., exhibited Giles & Tompkins' tool expander and other specialties, and were represented by C. C. Place.

The Standard brake slack adjuster of J. H. Sewell, of Worcester, Mass., attracted much attention—the full size apparatus was shown.

The Wilmington Malleable Iron Co., Wilmington, Del., exhibited Brown's patent malleable iron draft rigging and the Diamond coupler.

J. B. Brady and W. J. Cooke represented the Fox pressed steel truck and McGuire grain door or cars, at Clayton, N. Y., near Thousand Islands.

Taylor Flush Car Door Co., Chicago, had on exhibition on dock, sample of their new door, with Mr. E. F. Luce looking after their interests.

Pottier & Stymus Co., of New York, brought out their new car seats, and Mr. A. J. Stott was kept busy showing them to the master car builders.

The exhibit of the Cory lubricator by M. C. Hammett, of Troy, N. Y., was most interesting to the visitor who had never seen a device of this character.

Mr. A. D. Hamlin, of the Hamlin Car Step Co., had two models of his invention, which was one of the new things viewed by the master car builders.

Moran Flexible Steam Joint Co., of Louisville, Ky., were represented by Mr. H. M. Frankel, and T. W. Moran exhibited samples of their steam joint.

The Gelston rotating head coupler, manufactured by Pennsylvania Steel Castings & Machine Co., of Chester, Pa., was represented by Mr. E. C. Smith.

Scarritt Furniture Co., St. Louis, had photos of their car seats in the Thousand Islands House, and were represented by S. G. Scarritt and H. O. Nourse.

F. M. Patrick, the genial representative of H. W. Johns Manufacturing Co., of New York, had an exhibit of asbestos goods which attracted some attention.

The Hendrick Manufacturing Co., of Carbondale, Pa., made an exhibit of some of their perforated metals for railroad use. Mr. C. E. Retten was in attendance.

Among the exhibits of plush located in the Japanese pavilion, that of L. C. Chase & Co., of Boston, was unusually tasty, and was complimented by the car builders.

A very ingenious model of the Patten Self-Oiling Axle & Journal Co., of Baltimore, Md., was manipulated by Jas. S. Patten, the inventor, and Morton Schaeffer.

Chicago Railway Equipment Co., Chicago, represented by E. B. Leigh, A. J. Farley, L. C. Burgess and Fred Ely, exhibited their National hollow brake beam in the tent.

The exhibit of Acetylene gas was one of

the best at the convention. It is manufactured by the Acetylene Gas Equipment Co., 556 West Twenty-seventh street, New York.

The Rand Drill Co., of New York, exhibited the only air compressor shown at the convention. It supplied the air for the various new tools in the Machine Exhibit.

The Hale & Kilburn Manufacturing Co., of Philadelphia, Pa., exhibited their assortment of car seats, which were viewed by all, with many complimentary comments.

The Damascus Bronze Co., of Pittsburgh, Pa. (office in Lewis Block) exhibited main rods and side brasses in damascus and phosphor. J. T. Brown had charge of the exhibit.

The Boston Belting Co. had a display in charge of Geo. H. Forsythe and F. T. Allen, which came in for a large share of the attention of visitors to the Japanese pavilion.

The Ludlow Coupler Co., of Springfield, O., exhibited their car coupler and Miner drawbar attachment. J. T. Ricks and J. D. Rogers were the representatives in attendance.

American Balance-Slide Valve Co., of San Francisco, exhibited blueprints and samples of their balance-slide valve for locomotives, represented by J. T. Wilson, general manager.

The National Car Wheel Co., of Buffalo, N. Y., made an interesting exhibit of their car wheels which attracted general attention. W. H. Fenner and W. W. Turley were in attendance.

The Schoen Mfg. Co., of Philadelphia, Pa., exhibited a pressed steel bolster, corner irons, stake pockets and other car material. Chas. T. Schoen and J. T. Milner were in attendance.

The Davis Car Shade Co.'s exhibit from Portland, Me., was among the most attractive on the grounds. C. M. Fuller, E. E. Piper and J. T. Fuller made the display a great success.

Chicago Pneumatic Tool Co., of Chicago, in charge of J. W. Duntley, showed their new improved pneumatic hammer, which was one of the novelties of the convention, and attracted a crowd at all times.

The Lone Star coupler exhibit, in charge of Thos. H. Wheless, vice-president of the company, which attracted so much favorable comment at the convention, is illustrated on another page of this issue.

The Gold Car Heating Co., of New York and Chicago, secured a fine vantage spot directly in front of the entrance of the Thousand Islands House for their splendid exhibit, which was universally admired.

The American Balance Slide Valve Co., of San Francisco, Cal., and Jersey Shore, Pa., exhibited several varieties of their slide valves for locomotives at the convention. They were represented by Mr. Wilson.

C. H. Phillips, the veteran representative of Brown & Sharpe Mfg. Co., of Providence, R. I., was in attendance at the convention with an assortment of photographs of some of the special tools used in railroad shops.

The Gould Coupler Co. had a large exhibit, consisting of car, tender and pilot couplers and Gould continuous draft rigging. Mr. C. W. Gould, E. F. Luce and George O. Weidner were numbered among the visitors.

The Facer Forged Steel Car Wheel & Locomotive Wheel Co., Independent Building, Germantown, Philadelphia, Pa., is the address of the manufacturers of the Facer solid and forged steel wheels, who were represented.

The Crossman House contained the display of the Acetylene Gas Co., of New York. The brilliancy of this gas is surprising, when compared with incandescent electric lamps. Mr. J. Mitchell had charge of the exhibit.

The Consolidated Car Heating Co., of Albany, N. Y., had a splendid exhibit of their systems at the convention, and were ably represented by Chas. A. Sheldon, J. F. McElroy, R. P. Scales, W. P. Walman and Frank P. Foley.

Fox Solid Pressed Steel Co., of Chicago, had five standard New York Central box cars equipped with Fox trucks at Clayton, N. Y. W. O. Jaquette and James B. Brady, general sales agent, were in charge of the company's interests.

Adams & Westlake, of Chicago, represented by L. A. Gray, displayed their "Acme" automatic coach window shades by models for railroads and street railways, a line of brackets and other specialties manufactured by them.

The exhibit of the Safety Car Heating & Lighting Co., of New York, was certainly one of the brightest bits of advertising seen at the convention. J. J. Cody, C. H. Howard, R. M. Dixon, Merle Middleton and O. C. Gayley represented the company.

Buckeye Malleable Iron & Coupler Co., Columbus, O., exhibited blueprints showing a detailed description of their freight, passenger and tender equipment, as well as models of their coupler. John E. Howe, James Tims and Wm. E. Maher were in charge.

The Tyler Tube & Pipe Co., of Washington, Pa., gave a practical illustration of what can be done with their Algerite boiler tube iron in their display at the convention. Mr. Tyler and Mr. Molleson were among the most active members of the meeting.

Mr. James Rigby, the inventor and patentee of a new form of steel-tired wheel, manufactured by the Schellenberg Safety Car Wheel Co., Detroit, had on exhibition a pair of wheels made by his company. The wheels received the approval of many members of the association.

A. O. Norton, the enterprising manufacturer of ball-bearing screw jacks and Sure Drop track jacks, had a fine exhibit, and advertised it by renting several diminutive "Jack" mules (Rocky Mountain canaries), which were covered with the sign, "This is not the Norton Jack; see Exhibit."

C. B. Hutchins and Sons, Detroit, Mich., with branch office in The Rookery, Chicago, showed a large model of their well-known Morris car roof, designed by Mr. W. S. Morris. This was well represented by Mr. C. H. Hutchins and S. D. Anderson, who were in charge of the exhibit.

Manning, Maxwell & Moore, of New York, and the Ashcroft Mfg. Co., the Consolidated Safety Valve Co., and Hayden & Derby Mfg. Co., and their several specialties, were represented by C. A. Moore, F. T. Tapley, R. T. Boyle, E. A. Pedrick, J. W. Gardner and N. L. Hayden.

The Moore Car Door Co., of Chicago, had on exhibition in the tent a working model of a car door, provided with their improved fastenings and attachments. This door caused favorable comment by those who examined it and listened to Belden D. Jones, who represented the above company.

Chicago Grain Door Co., Chicago, in charge of James L. Mallory, displayed their grain doors, new door fastener, and other specialties on veranda of pavilion, and distributed a handsome souvenir paper weight, in the form of a genuine World's Fair admission ticket between glass.

The Williams Typewriter Co., of 253 Broadway, New York, realizing how the mechanical features of their typewriting machine would appeal to railroad mechanical men, sent one of their machines to the recent convention, in charge of H. D. Wilde, where its fine work was greatly admired.

The Q. & C. Co., Chicago and New York, exhibited models of the McKee brake adjuster and Williams locomotive valve-setting device in the pavilion, in charge of J. K. Lencke, who created no little amusement with his celebrated "Lung Tester," the best "sell" on the grounds.

Pratt & Lambert, New York and Chicago, who exhibited some beautifully finished panels, showing Faultless varnishes and Bellamy filler, were represented by Mr. C. L. Bellamy, J. B. Gowing, W. H. Andrews and John B. Hicks, who were much sought after while their useful souvenirs lasted.

National Malleable Castings Co., of Cleveland, Chicago, Toledo and Indianapolis, exhibited the Tower coupler, Eubank car door, Coffin carline and sill pockets and malleable castings in the tent. The company were represented by Willard A. Smith, C. L. Sullivan, J. V. Davidson, S. L. Smith and F. R. Angell.

The best patronized of all the exhibits at Alexandria Bay was that of A. Major, of New York City, whose patent ice float keeps water at the temperature of a spring, keeps it clean and makes a great saving in the consumption of ice. It is especially adapted for railroad use, both in cars, stations and shops.

The Shickle, Harrison & Howard Iron Works, of St. Louis, exhibited body and truck bolsters on the lawn between the pavilion and the tent. These bolsters are guaranteed for the life of the car, being thoroughly tested before delivery. The exhibit was in charge of J. W. Duntley, their general sales agent.

The Acme Coupler Co., who are located at 26 Cortland street, New York, were represented by A. D. Keys, F. A. Fox and Frederick A. Guild, who expressed themselves as being more than pleased with the result of their visit. The Acme coupler came in for a good share of attention during the M. C. B. Convention.

The Boies Steel Wheel Co., of Scranton, Pa., displayed several of their steel wheels cut to show wrought-iron center and steel tire—the two parts only of which the wheel consists. Safety, durability and economy are the points claimed for the Boies wheel, and the right metal in the right shape goes to the right place.

T. F. De Garmo, the popular representative of the Burns coupler, manufactured by the Syracuse Malleable Iron Co., exhibited a beautifully finished and artistic model of that coupler, which was particularly admired by the ladies, who agreed that it deserved a place of honor in the hotel parlor where they could admire it more.

The Automatic Injector Co., of Cincinnati, O., exhibited a Hogue injector attached to a boiler, where its fine qualities attracted considerable attention at the convention. The display was in charge of

Mr. J. V. Motter, who has a reputation for knowing how to show up a good thing. The Climax oil injector was a part of this practical display.

Mr. J. M. Foster, president of the Foster Engineering Co., of Newark, N. J., made an attractive exhibit of their inside safety boiler check, the Foster pressure regulator, pump governor, and a very simple engineer's order clip which has been adopted as standard on the Vanderbilt lines. Manning, Maxwell & Moore are New York agents for these goods.

The Magnolia Anti-Friction Metal Co., 74 Cortlandt street, New York, exhibited a sample bearing of their Magnolia metal, which ran 20 minutes with 2,000 pounds per square inch, yet showed no trace of wear. A new pamphlet, showing half-tone cuts taken from photographs and giving all the latest tests, will be sent to any address, on application.

The Union Grease Co., of Boston, Mass., were advertised everywhere in hotels and on grounds by their enterprising managers, Messrs. C. M. Fuller and W. H. Drury. Three candidates for the greased pole prize, offered to the one who succeeded in securing the envelope on the end of a pole extending over the water, will have occasion to remember Union grease, too.

Mr. H. F. Inglehart, proprietor Hotel Westminster, Westminster Park, Alexandria Bay, Thousand Islands, won many friends and future patrons through his splendid treatment of his guests during the recent convention. The Westminster is an exceedingly comfortable and well-kept hotel, as is also The Columbian, at Thousand Islands park, also kept by Mr. Inglehart.

Mr. Horace Jones, of the A. E. Filley Mfg. Co., 39 Cortlandt street, New York, succeeded in interesting many of the master car builders and railroad men in their "Defiance" car-roofing material, and all who listened to his statements concerning asphalt products were convinced that the "Defiance" brand had all the qualities claimed for it. They have a new pamphlet and samples which are worth sending for.

The Alexander car replacer, manufactured in Scranton, Pa., was ably represented by its inventor, Mr. R. E. Alexander. This very valuable device is made of pressed steel, and is wonderfully light and strong, and works to perfection. There were many difficulties in the way of manufacturing it which are now happily overcome. It is fully explained in a neat illustrated circular, which will be sent, on application to the Alexander Car Replacer Co., Scranton, Pa.

The Dumping Car Improvement Co., of New York (26 Cortlandt st.), deserve great credit for their enterprise in getting one of their full size cars to the dock of the Crossman House, Alexandria Bay, 7 miles away from any railroad; but they did it, and explained the car to many admiring car builders and railroad men on a barge chartered for the purpose. Mr. Wm. McMahon, Hector De Castro and D. S. Robeson represented the interests of this new company at the convention.

Keasby & Mattison Co. were one of the best represented concerns at the convention. The method of applying their Magnesia covering on locomotives, and the fastentening, was nicely shown on a large model by Mr. W. W. Johnson and Thos. Rose, and attracted considerable attention. This well-known company have some interesting pamphlets, which should be in the hands of all master mechanics and superintendents of motive power. The office and works of the company are located at Ambler, Pa.

The Sams automatic coupler was the only link and pin type at the convention which comes under the requirements of the law as an absolutely automatic coupler. The strong points of the Sams coupler are its simplicity, durability and cheapness, in connection with the advantage that any railroad can obtain a license to make and use it (with the exception of the pin) out of their old scrap materials—the pins costing only $1.00 each, f. o. b., Detroit, Mich. Undoubtedly many roads will adopt this coupler for the above reasons before the new law is enforced.

The Standard Paint Co., No. 2 Liberty street, New York, were well represented at the convention, and distributed a useful souvenir in the form of a card case and tablet made of Mexican grass. *These* were in great demand. Mr. H. J. De Ronde, the enterprising sales manager of the Standard Co., will send one of these souvenirs to all railroad men interested in acid and gas-proof roofing material for cars, roundhouses, etc., or in insulated paper for refrigerator cars. This is the same company who issue for free distribution the sample book of roofing materials which costs them $1.00 each.

McIntyre & Co., the photographers at Alexandria Bay, N. Y., who photographed groups of master car builders and master mechanics at both The Crossman and Thousand Islands House, during the recent convention, are now ready to supply duplicates, mounted or unmounted, at $1.00 each for the largest size pictures. This company have a full assortment of pictures (several sizes) of all the best views, and will shortly issue a list to include all the new pictures, groups and fishing parties taken during the convention. Full particulars and prices sent on application. The pictures will be carefully packed and guaranteed.

Among the railroad supply people who attended the conventions for the first time, none on the grounds worked harder and made a more favorable impression than Mr. Thos. H. Wheless, who represented the Roosevelt-Wheless draft box, of Austin, Tex., and the Lone Star Coupler Co., both exhibits receiving careful attention. Mr. Wheless is a lawyer, inventor, student, philosopher and genial gentleman all in one, as his many new friends made at the meeting will testify. He is a brother of Malone Wheless, who invented the wonderful new electric traction system about to be adopted in New York and other cities, to do away with cable, trolley and steam motors.

E. Harrington, Son & Co. (Incorporated), North Fifteenth street and Penn avenue, Philadelphia, Pa., exhibited one of their chain hoists with the improvements lately made on same. They were represented by Mr. Wm. H. Harrison, who had photographs of the latest improved tools for railroad and locomotive shops. Among these are the extension bed engine lathes, made so that the bed can be extended to allow for larger swing and longer distance between centers. Five sizes are made, regular standard engine lathes from 16 to 60 inches swing; standard upright, radial, gage and locomotive frame drills; boiler-head manhole tinning machine, which is made portable; stay-bolt nicking machine, nicks five at a time.

Hinson Coupler Drop Test.

The Hinson coupler was lately subjected to an unusually severe test by Robert W. Hunt & Co. The bar and knuckle are made of steel. This was placed under the drop, with the following results:

Blows,	Height, feet.	
1	5	All right.
2	5	All right.
3	5	All right.
1	10	All right.
2	10	Pivot pin bent.
3	10	Shank bending slightly.
1	15	Shank bending slightly.
2	15	Shank bending slightly.
3	15	Knuckle down on face.
4	15	Shank bending.
5	15	Small crack in shank.
6	15	Same.
7	15	About the same.
8	15	Drop strikes guard arm.
9	15	Drop wedged between guard arm and knuckle and wedged face off.

Fracture, good—small blowholes.

The C. W. Hunt Co., New York, have issued a handsomely illustrated catalogue, showing the machinery which they make for industrial railways. There are some very peculiar-looking locomotives in the catalogue and cars of all kinds, suitable for railroad construction, mining, coal handling and a great variety of other purposes. People interested in engineering work of railroad construction would do well to supply themselves with a copy of this catalogue, which can be had on application to the company.

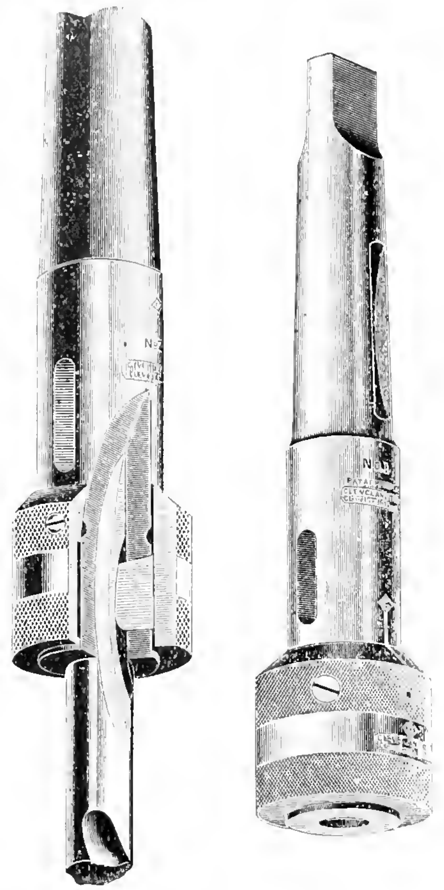
The new summer schedule of the Long Island R. R. went into effect June 27th. The passenger traffic on this popular system, which reaches all the beautiful resorts on Long Island, is now at "high tide." The company have just issued a handsomely illustrated book describing the resorts and country traversed by their 390 miles of road, equipped with the best of motive power and rolling stock for express service. They are building several extensions at present, and will add more as they are needed.

In the May issue of LOCOMOTIVE ENGINEERING, attention was called to a pamphlet on "Locomotive Cylinder Lubrication," published by the Lackawanna Lubricating Co., of Scranton, who are meeting with great success in the introduction of their single sight-feed lubricator. The requests for copies of this treatise were so many that an additional lot had to be printed. These are now ready for free distribution, and copies may be had on application.

The office of the Cleveland Twist Drill Co. has been removed from 102 Reade street, New York, to 99 Reade street, where a complete stock of twist drills and other tools made by the company are to be seen. Mr. C. I. Markham, the agent in charge, invites all interested to call.

Grip Socket.

This grip socket is designed to hold and drive taper shank drills and other tools. A groove, which is an arc of a true circle, is milled in the shank of the drill or tool—



as shown in above illustration—a key let into the body of the socket fits into the groove, and is *locked* securely in place by a turn of the revolving-internally, eccentrically-counterbored collar.

After the key is locked, it is impossible for the tool to slip in the socket or to be pulled out until the collar is turned back again to release the key. The end of the collar is beveled, and a plain index mark on it and on the body of the socket shows when the key is released.

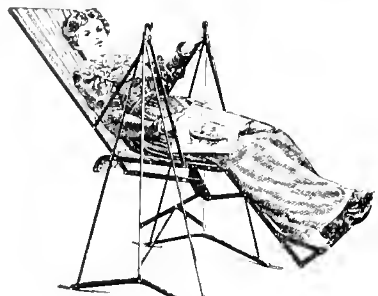
Drills or tools that have had the tangs on the shank twisted off can be used in these grip sockets successfully, and in this way the cost of the sockets can be saved many times annually. Boring bars for undercutting can be used without any danger of their pulling out of the sockets, and the labor and expense of turning over heavy pieces saved.

These sockets are made by the Cleveland Twist Drill Co., Cleveland, O., turned out by the factory ready for use.

The Rogers Locomotive Co. lately furnished two 14 x 20 locomotives to the Cross Creek Coal Co. of Pennsylvania, which are equipped with the "Lackawana" single sight-feed cylinder lubricators, made by the Lackawanna Lubricating Co., of Scranton, Pa.

Ease and Comfort.

The J. P. has given up going to the seashore for the season. Stannard & White, of Appleton, Wis., sent him one of their swinging seats, that automatically changes to a hammock when he stretches his legs, and wakes him up for dinner when the bell rings, and he came to the conclusion that he could take more comfort at home. Stannard & White make the best cab seat extant, and sell lots of them, but they are anxious to introduce this new easy chair, for out door and in, and knowing that railroad men and their families need and



appreciate comfort as much or more than anyone else, they offer in their advertisement this month to give one of these five-dollar chairs with every order for a cab seat received between July 10th and August 10th.

From personal use the J. P. declares that the saving of and prolonging of life is at least 15 per cent. by the use of the chair.

There is only one objection to the chair, and that is the necessity of buying a second one for your wife, or resorting to all kinds of underhanded tricks to get her out of it so that you can get in.

In referring to notice of the Page Woven Wire Fence Co., Adrian, Mich., in our June issue, we neglected to mention that the Lake Shore & Michigan Southern Ry. have in use over 300 miles of their fencing, some thirty other roads about 100 miles each, and several roads are buying it in car-load lots (10 miles to car load). Their railroad salesman, E. G. Fisher, is now in Europe, attending the International Congress now being held in London.

Railroad men who are making a study of couplers, should send for memoranda of latest tests, contained in a brief pamphlet issued by the Standard Coupler Co. from their New York office.

The Standard Paint Co., of New York, have just closed another contract with the Merchants' Despatch Transportation Co., of East Rochester, New York, to supply them with over half a million square feet of their Giant P. & B. insulating paper, for insulating the 200 additional refrigerator cars that they are now building. With this order they will have supplied the Merchants' Despatch Co. this year with over 1,500,000 square feet of their Giant P. & B. insulating paper.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(89) W. G. W., Baraboo, Wis., asks:

Would like to know about the M. E. P. of a 19 x 24 cylinder, working full stroke, just dragging a train up a grade, if the boiler pressure is 180 pounds? *A.*—About 160 pounds.

(90) C. H. A., Philadelphia, writes:

I notice in the dimensions of Delaware & Hudson engine that the valve has ¼ lap in back motion. Why is this done? *A.*—Its effect is to restrain the increase of lead opening in forward gear when the engine is linked up. It is generally spoken of as negative lead.

(91) J. A. M., Columbus, O., asks:

What would cause the filling plug on a Detroit lubricator No. 3 to melt out, lubricator feeding all right, until it would get empty; then the babbitt in filling would melt out? Cannot account for it. Something I never saw or heard of; did you? *A.*—No. Have no idea what caused it.

(92) G. R. S., St. Paul, Minn., writes:

I am interested in what patents have been taken out for a certain invention (named). Could you give me particulars through your columns? *A.*—No; we cannot spare time to make researches which are not of general interest to our readers. Employ a good patent attorney, and he will obtain the information sought.

(93) E. B., Baltimore, asks:

Is the time credited to a Pennsylvania engine, on the Atlantic City run, April 22d, correct and true? *A.*—The distance from Camden to Atlantic City is $58\frac{3}{10}$ miles, which was made in 45 minutes—an average speed of 76½ miles an hour. This was done with an engine and one car. It is not faster than time made daily on several roads.

(94) S. M. B., Elkhart, Ind., asks:

Who was the inventor of valves? I mean, who invented a device for opening and closing a pipe, or spout, or anything of that kind? *A.*—This is one of the inventions that is not recorded in patent papers. Valves were probably first used in connection with bellows, and bellows were doubtless used since the dawn of civilization.

(95) C. R. M., Charleston, S. C., writes:

I have been making a variety of experiments in which I require coil springs, and I don't appear to have hit on the best way of tempering. Can you send me directions? *A.*—The best directions we can give is to recommend you to get the springs made by a good spring maker. Our advertising pages will give you the address of people in the business.

(96) Fireman, Indianapolis, Ind., writes:

How is it that when we read of a locomotive running away without anyone on her, it is reported to run at sixty miles an hour and keep up the speed till something is struck, no matter how far she may run? If I were to stop firing, my engine would not run five miles. *A.*—The imaginative reporter helps the speed and distance that runaway locomotives make. As the injector is shut off, a runaway will generally go farther than a controlled engine.

(97) R. B., Atlanta, Ga., writes:

Is it a fact that the wearing hollow of valve seats in the middle is confined to link-motion engines that give a varied travel of valve? Is it due to the valve travel being in the middle more than at the ends? *A.*—Link-motion engines are

not the only ones that vary the valve travel, and it does not appear that the wearing hollow of valve seats is confined to engines having varied valve travel. Valves with a constant travel wear the seats hollow in the middle also. There is diversity of opinion as to the cause of this.

(98) T. S., Wheaton, Minn., writes:

Please answer the following questions in LOCOMOTIVE ENGINEERING: 1. How do you locate a pound in an engine? *A.*—Place the engine on top or bottom quarter. Have the fireman admit a little steam and reverse the engine to and fro, while you listen for the pound. 2. How would you commence to key up mogul or ten-wheel engine? *A.*—At the main driving wheel. 3. How can you set a slipped eccentric? *A.*—Look up directions in a book on the locomotive. 4. Will an engine pound if pedestal bolts are loose? *A.*—Yes. Why? *A.*—Because the pedestal brace will drop down and leave the driving boxes loose.

(99) W. S. B., Chicago, Ill., writes:

1. What takes place in the steam chest of a locomotive when the engine is running reversed? *A.*—The ports open so that the pressure in the steam chest presses against the advancing piston the greater part of the stroke. For a short distance the receding piston creates a vacuum in the cylinder, which is filled by admission of air through the exhaust pipe. During another part of the stroke the piston pumps the air or steam in the cylinder back through the steam chest into the boiler. This question is fully answered on page 217 of the last edition of Sinclair's "Locomotive Engine Running." 2. When wheels are slid, are they not raised higher off the rail than when they revolve? *A.*—No.

(100) J. V. R. S., Quincy, Ill., writes:

1. What is the travel of a valve in 6 inches, cut off with 5 inches eccentric throw? *A.*—About 2½ inches. 2. Does the lead wear open or shut? *A.*—The tendency of wear is to reduce the lead. 3. Which wears the most, driving boxes, wedges or shoes? *A.*—That will depend on the quality of metal in either of the parts. 4. How can I tell when my engine has too much lead? *A.*—By measurement of the lead opening when the piston is on the center. 5. I have a Nathan lubricator; when I set it, it feeds all right for a while and then gets tardy; had it cleaned with lye and gave it a new choke valve, but it worked the same. Have you a remedy for it? *A.*—Study an article on lubricators by George Royal, on page 176 of our March number. 6. Does the crosshead stand still in the guides at either center? *A.*—Yes. The crossheads stop when the crank pin is on the center.

(101) J. D., Christchurch, New Zealand, writes:

1. What are the advantages of the Richardson balanced valve and of the sniffle valve? *A.*—The Richardson balanced valve, by relieving the pressure on the valve seat, greatly prolongs the time the valve can be run before facing is necessary. The "sniffle" or relief valve, as it is called in this country, supplies air to the steam chest when an engine is running without steam. There is some conflict of opinion about its utility. 2. How can you tell on which side the springs of a Richardson balance are causing a blow of steam? *A.*—If you listen, with your ear to the steam chest, when an engine is working you can generally hear a rattle, caused by the broken spring. If you put the valve on the middle of the seat when the engine is standing and listen at the steam chest, you can generally hear the rush of escaping steam when the throttle is opened. This latter question is asked also by F. G. B., San Antonio.

(102) J. W. G., Brooklyn, N. Y., writes:

1. It is claimed that lining main rod too short or too long will cause exhaust to sound "lame." Why is this? *A.*—When the rod is too short or too long, it makes the travel of the piston uneven, so that more steam is admitted at one end than at the other; this will make parts of the exhaust stronger than others. 2. Given the annular opening in single exhaust nozzle, diameter of front end, and size of base of stack, how will you find the angle of expansion of steam for a given height of nozzle? *A.*—This can be determined only by experiment. 3. For what purposes are balance springs on driver-brake head used? *A.*—To balance the shoe and keep one end from rubbing the wheel. 4. Feed glasses in new improved No. 2 Detroit lubricators stop up when engine is backed up and weather is only moderately cold. Can you give me any reason for this action? *A.*—The makers of this lubricator say that the defects spoken of must have been caused by the steam pipe from boiler being improperly connected. 5. Has anyone ever published a dictionary of railroad terms and names? *A.*—The Master Car Builders' Dictionary, published by the *Railroad Gazette*, New York, comes as near this as anything we know of.

SHORT JOURNEYS ON A LONG ROAD.

Is the characteristic title of a profusely illustrated book containing over one hundred pages of charmingly written descriptions of summer resorts in the country north and west of Chicago. The reading matter is new, the illustrations are new, and the information therein will be new to almost every one.

A copy of "Short Journeys on a Long Road" will be sent free to any one who will enclose ten cents (to pay postage) to GEO. H. HEAFFORD, General Passenger Agent Chicago, Milwaukee & St. Paul Railway, Chicago, Ill.

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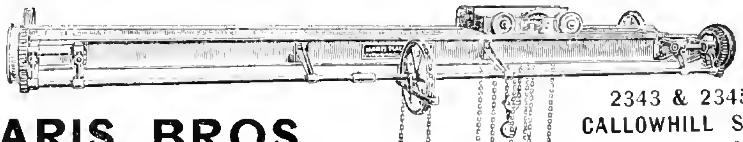

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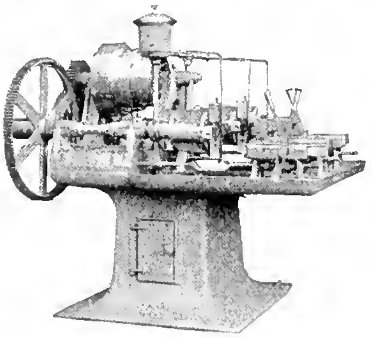

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Second-Hand Machinery,

FOR LOCOMOTIVE AND ENGINE WORK.

LATHE—
84" swing, 18' bed, complete "Lincoln."
72" " 20' " " "Union."
43" " 16' " " "N.Y.S. Eng. Co."
25" " 12' " " "New Haven."
20" " 10' " " "Harrington."

PLANER—
64" x 15' complete, "Pond."
42" x 10' " "Gleason."
30" x 10' " "Harrington."
24" x 5' " "Gray."

SHAPER—
14" Traveling Head, with Index Centers, Circular Feed and Vise, "Fitchburg."

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18" stroke, complete, "Bement."

HOR. BORING AND DRILLING MACHINE—
Swing 54", complete, "Sellers."

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38", complete.

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1½", with Taps and Dies, complete.

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Horizontal or Floor Boring Machine, Pratt & Whitney.
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40-inch Bement Vertical Drilling Machine.
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1 No. 3 Brown & Sharpe Universal Grinder.
2 Bement Car Axle Lathes.
2 " 33-inch Car Wheel Borers.
1 " 42 inch " "
1 100-Ton Hydraulic Wheel Press.
1 60 " Watson & Stillman Broaching Press.
1 9-inch Bement Slotter (all feeds).
1 43 " Vertical Boring & Turning Mill.
1 14 " Lowell Traverse Shaper.
1 25 " Prentice Bros.' Drill, Power Feed and B. G
1 30 " " " " " "
1 32 " 8 ft D. W. Pond Eng. Lathe (very heavy).
1 36 in. x 36 in. x 10 ft Pond Planer.
1 2½-inch Hurlburt Cutting-off Machine.
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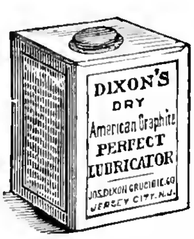

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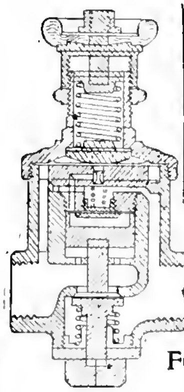

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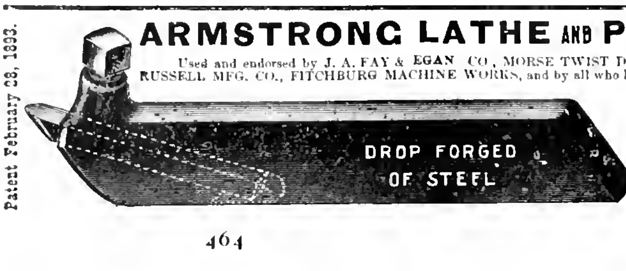

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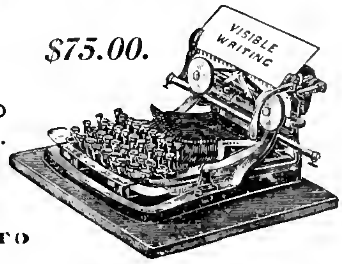

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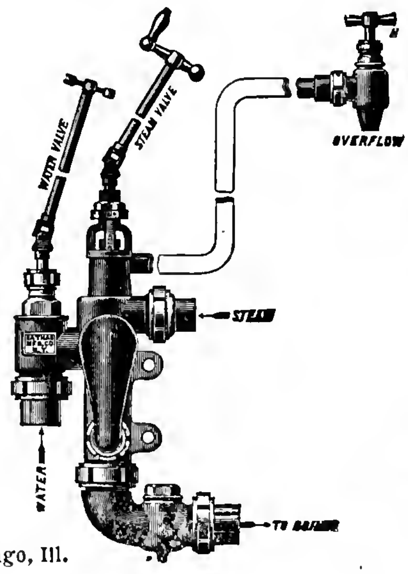

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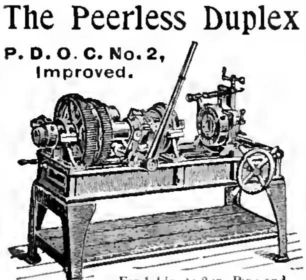

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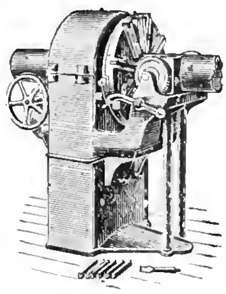

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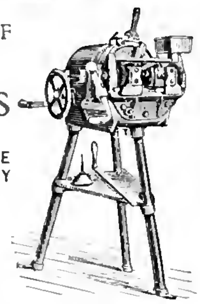

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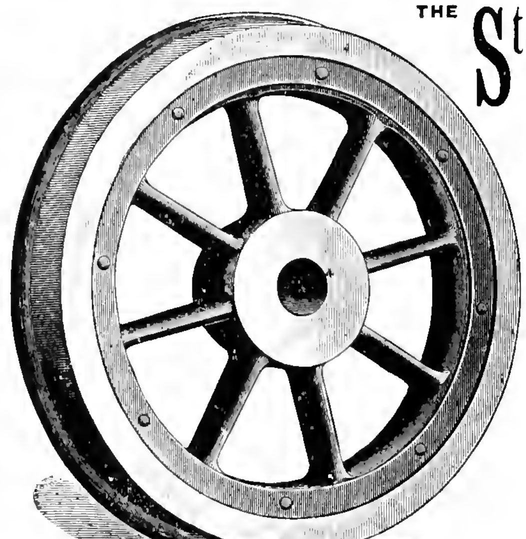

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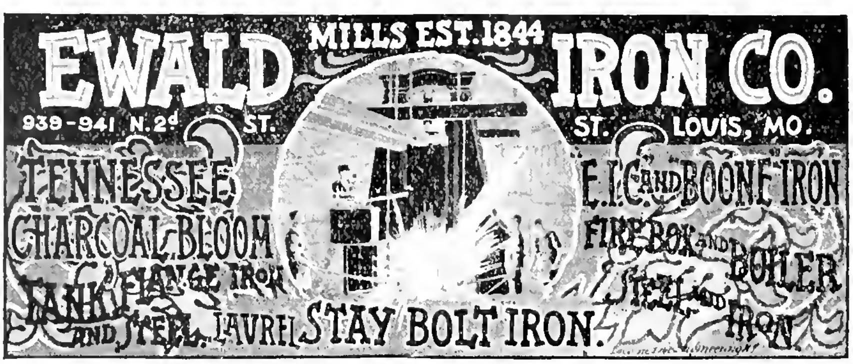

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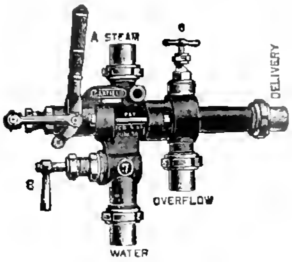

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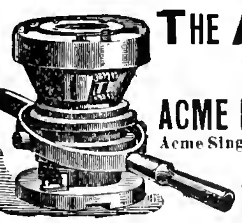

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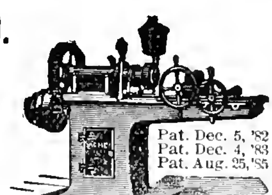

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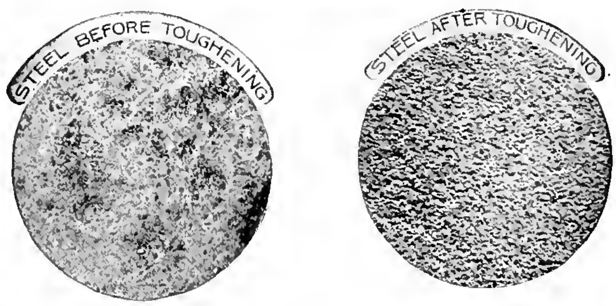

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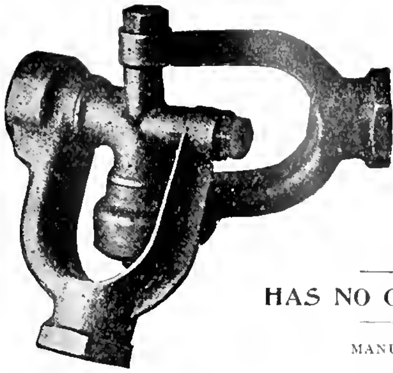

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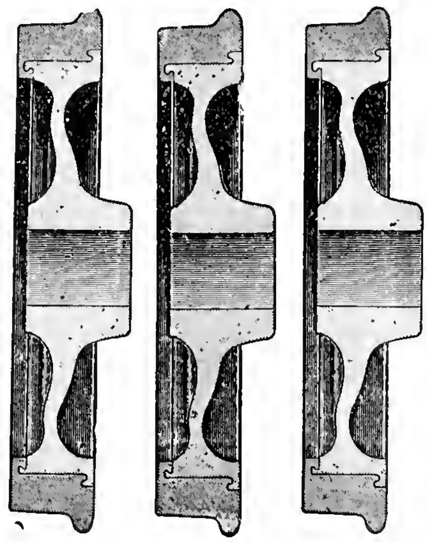

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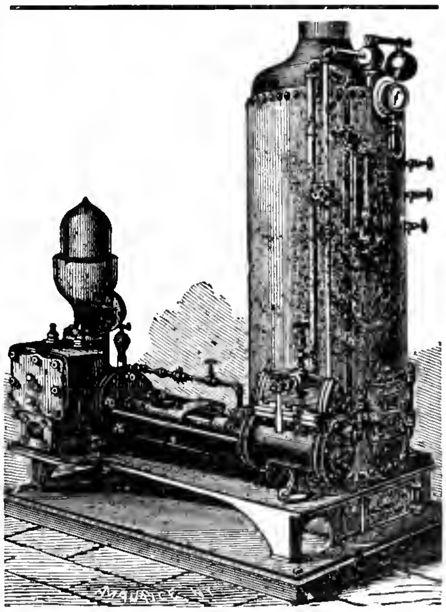

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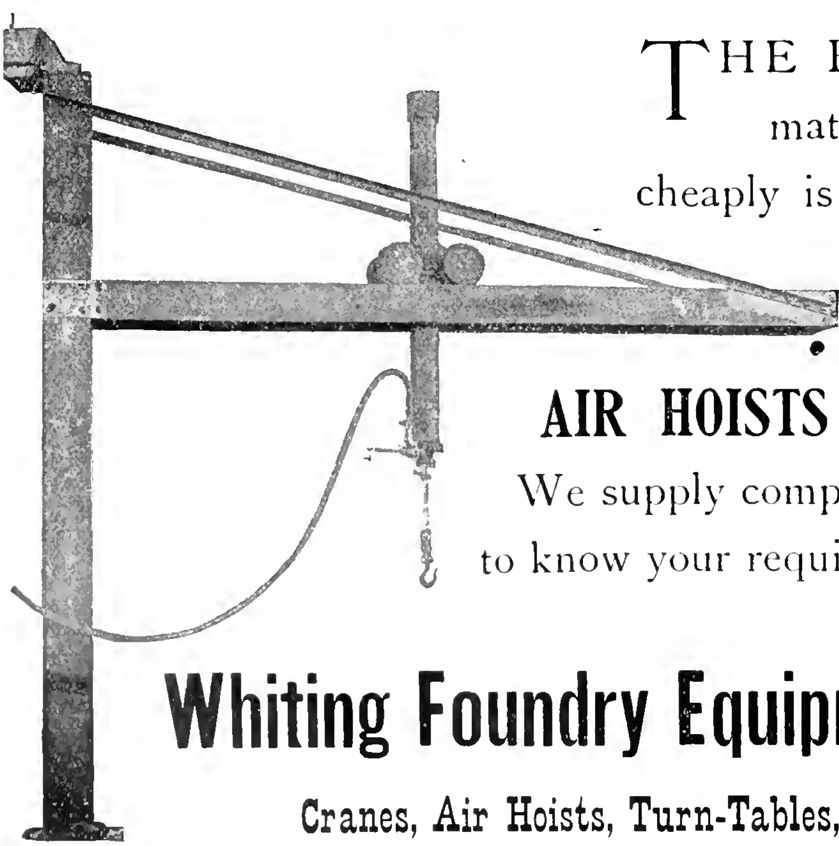

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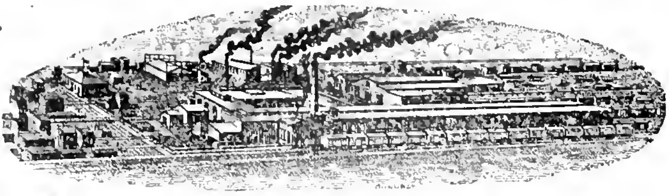

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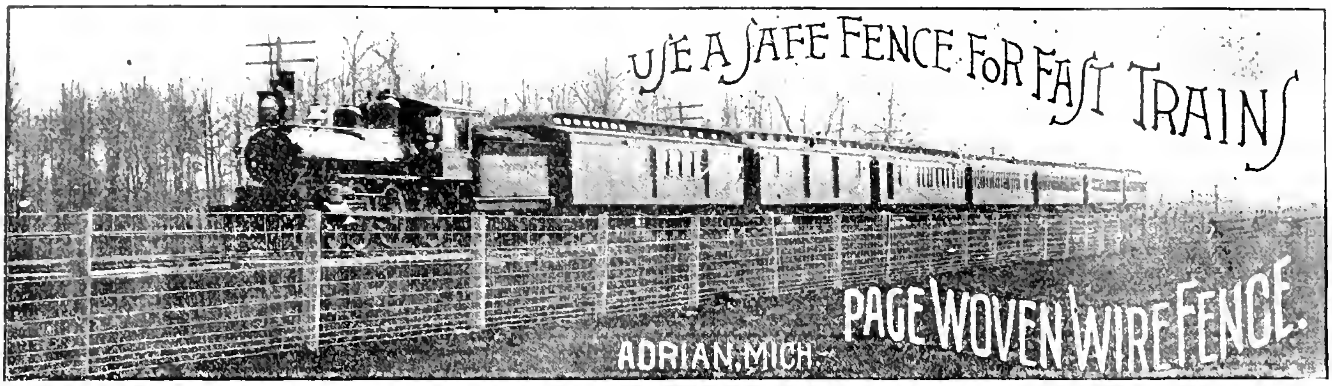

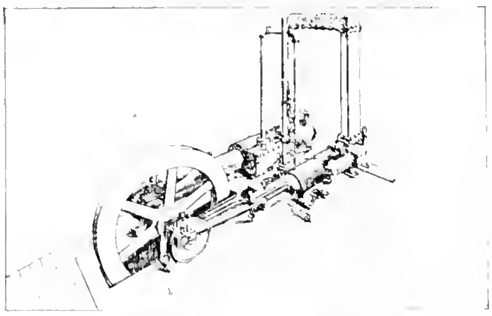

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This is the best construction for small and medium sizes.

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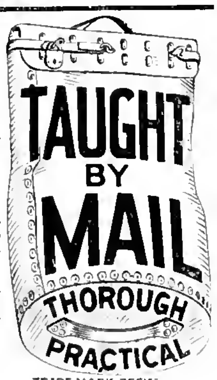

Steam Engineering (Stationary, Locomotive or Marine); Mechanics; Mechanical Drawing; Electricity; Architecture; Architectural Drawing and Designing; Masonry; Carpentry and Joinery; Ornamental and Structural Iron Work; Railroad Engineering; Bridge Engineering; Municipal Engineering; Plumbing and Heating; Coal and Metal Mining; Prospecting, and the English Branches.

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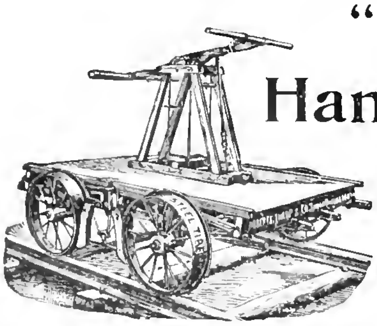

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EASY RUNNING, LIGHT IN WEIGHT, PERFECT WHEEL.

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DIFFERENTIAL

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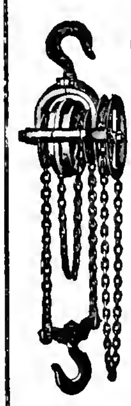

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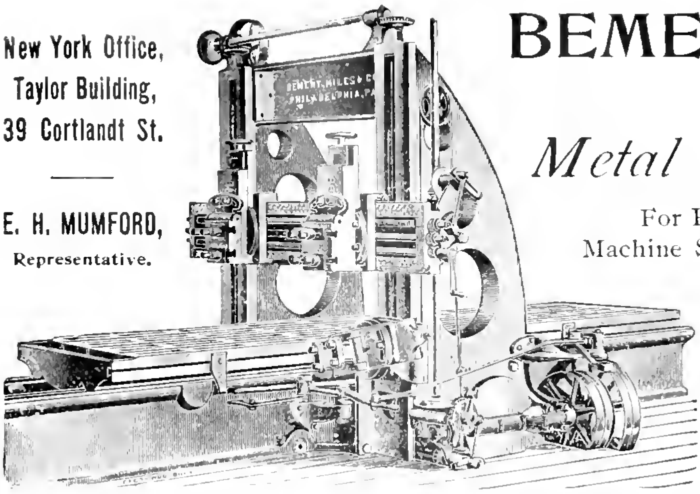

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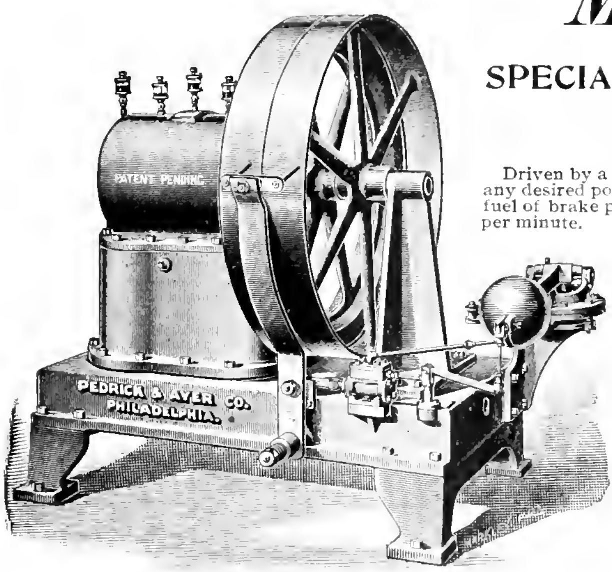

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That can be used under low ceilings, on a timber, the arm of a jib crane, etc. It locks and sustains load indefinitely, air or no air. Goes where regular hoist won't. An improvement all around. No chain hanging down in the way.

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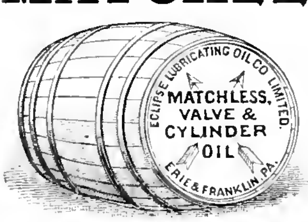

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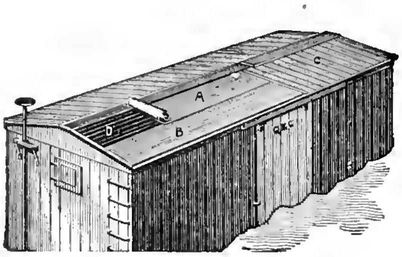

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THE COMING ROOF!

HEAVY, DURABLE AND STRONG.
WILL WEAR LONGER THAN ANY METAL ONE.

COSTS FROM $10 TO $15 LESS PER CAR.
CAN BE PUT ON IN ONE-HALF THE TIME.

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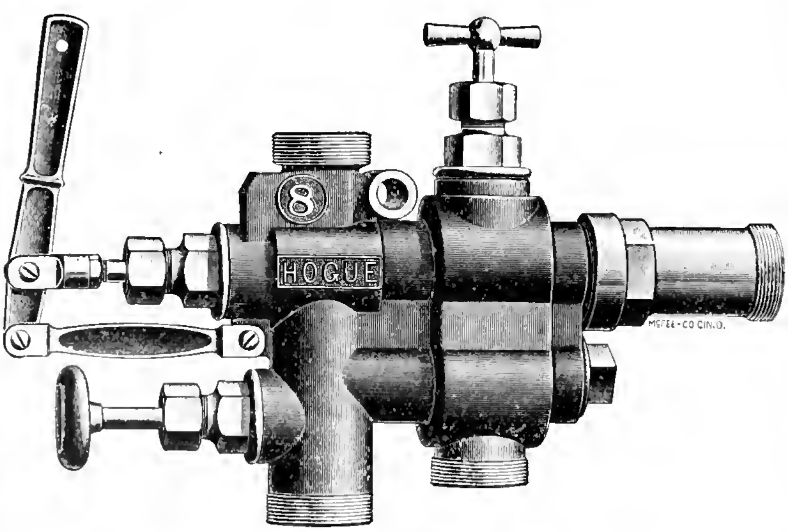

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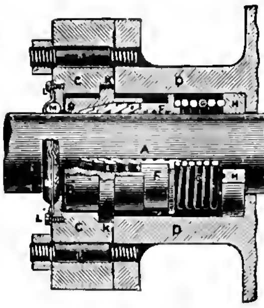

This is the Standard Metallic Packing all over the world, and is more generally adopted and in use on more locomotives than any metallic packing. Give the **JEROME** a trial. Put it in competition with any other packing and be convinced of its superior merits.

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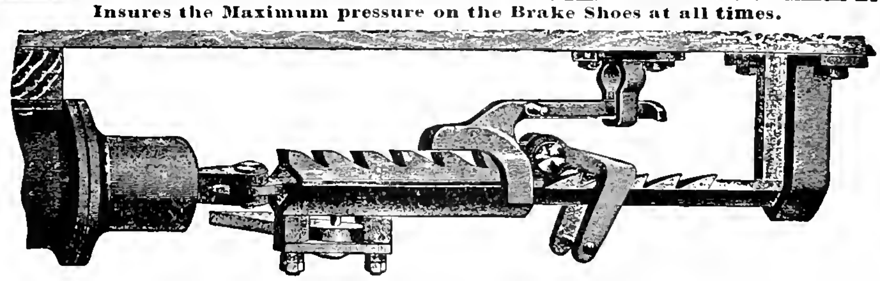

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Of Modern Design,

To meet any conditions.

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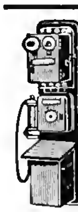

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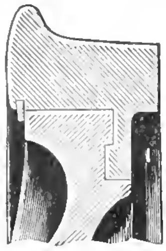

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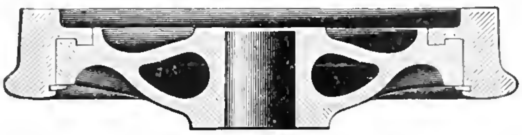

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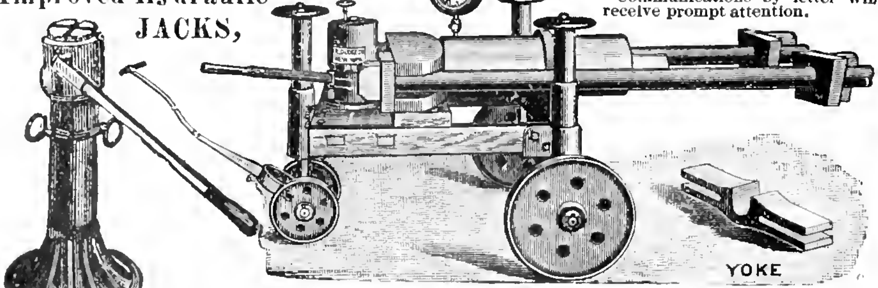
Improved Hydraulic JACKS,

☞Jacks for Pressing on Crank-Pins or Car-Wheels made to order. Communications by letter will receive prompt attention.



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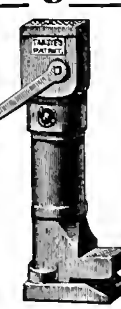

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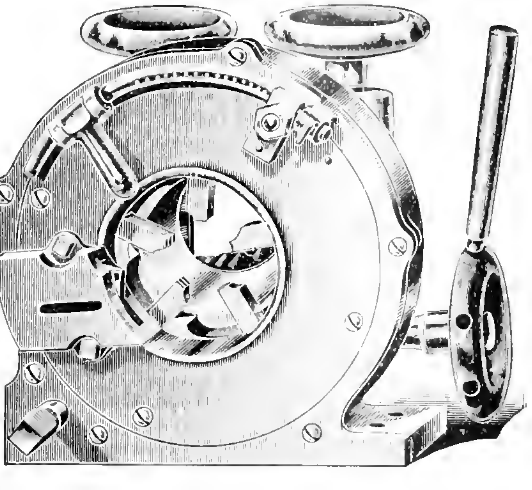

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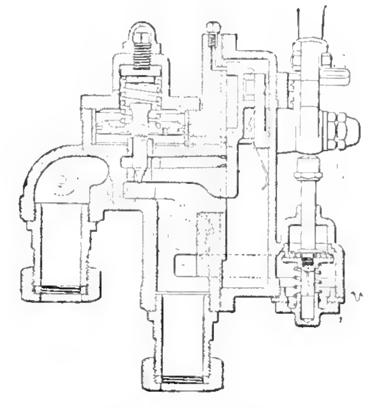

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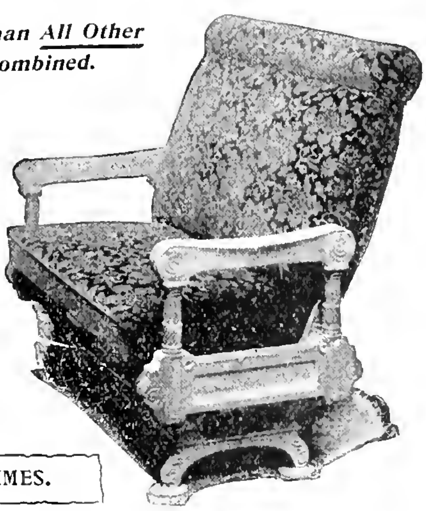
Output Larger than All Other Seat Makers combined.

Over 150 Roads Use these Seats.



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Our "Walk-Over" Pattern is the Finest of its class.

See cut of "Standard" here next month.

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IMPROVED LOCOMOTIVE STEAM GAUGE.

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SPECIAL SEAMLESS DRAWN TUBING.

Only Gauge where Movement Frame and Spring are removed from contact with back of case.

ELASTIC PACKING MAKES CASE AIR TIGHT.

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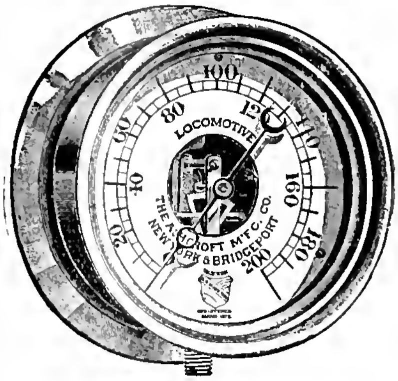

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SPRINGS OF FINELY TEMPERED STEEL.
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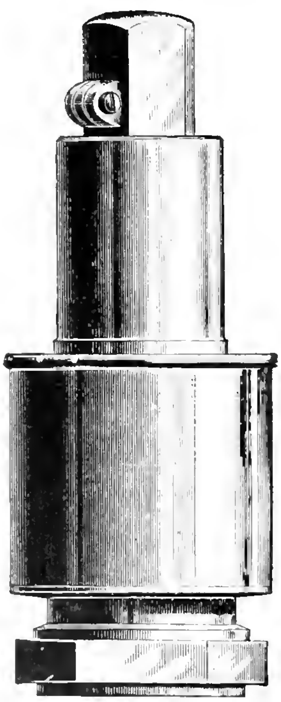
THE MUFFLER IS A SIMPLE ATTACHMENT TO RICHARDSON'S WELL-KNOWN ENCASED



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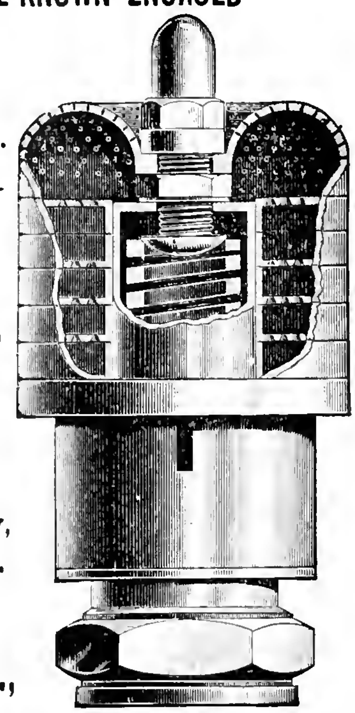

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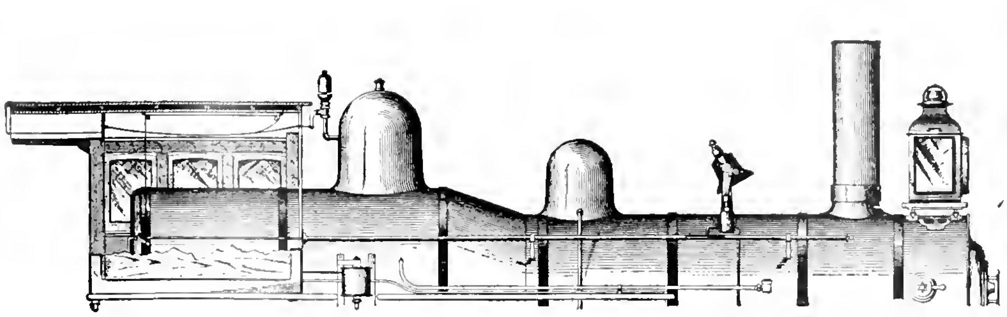

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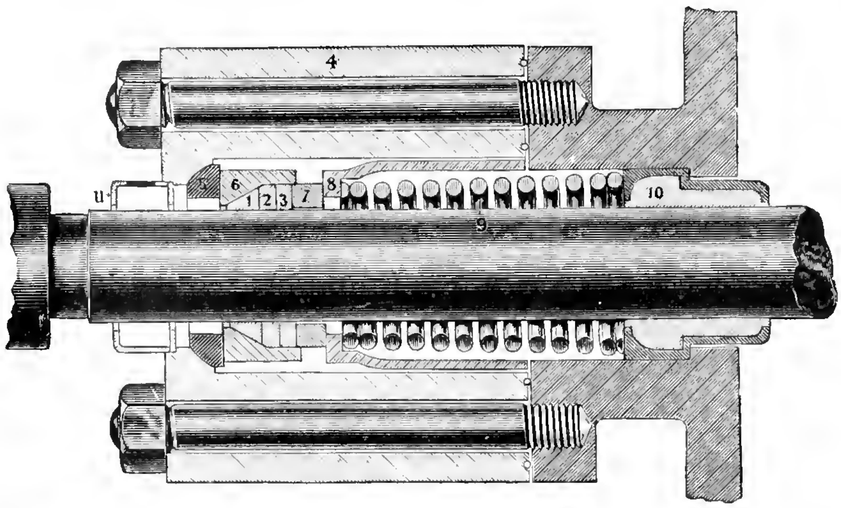

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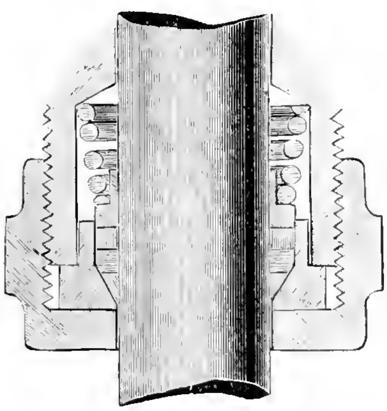

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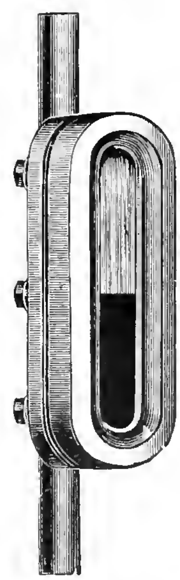

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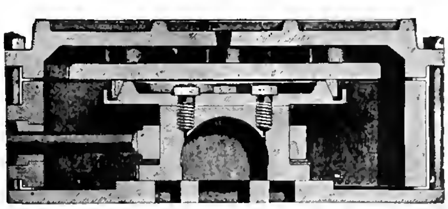

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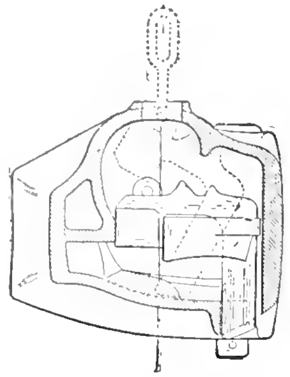

Sectional view back of lock looking forward. Dotted lines show the lock lifted full height for uncoupling and opening knuckle, and ready to couple again.

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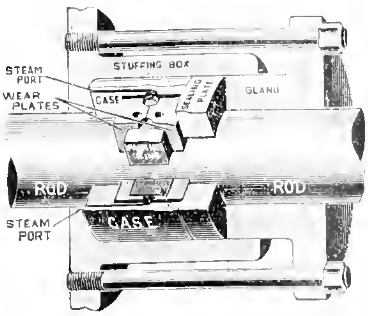

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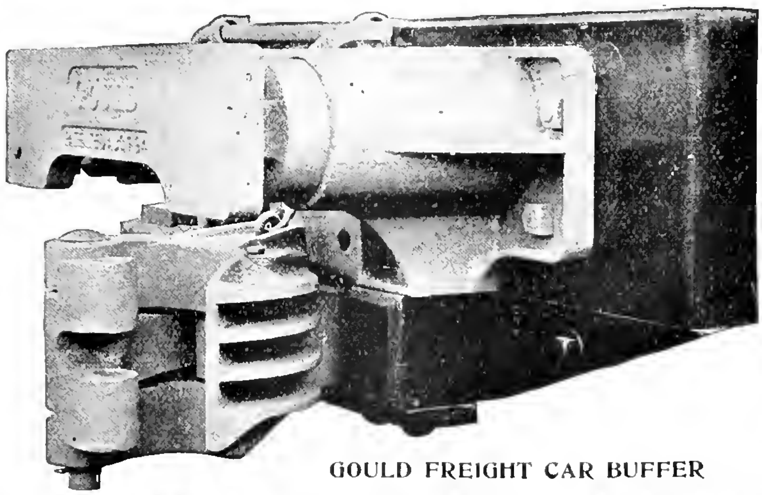

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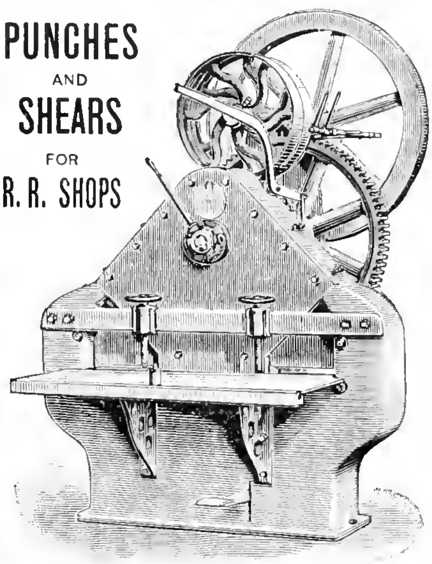

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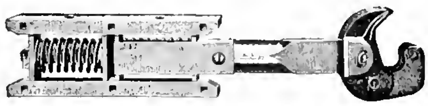

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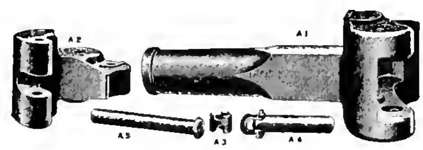

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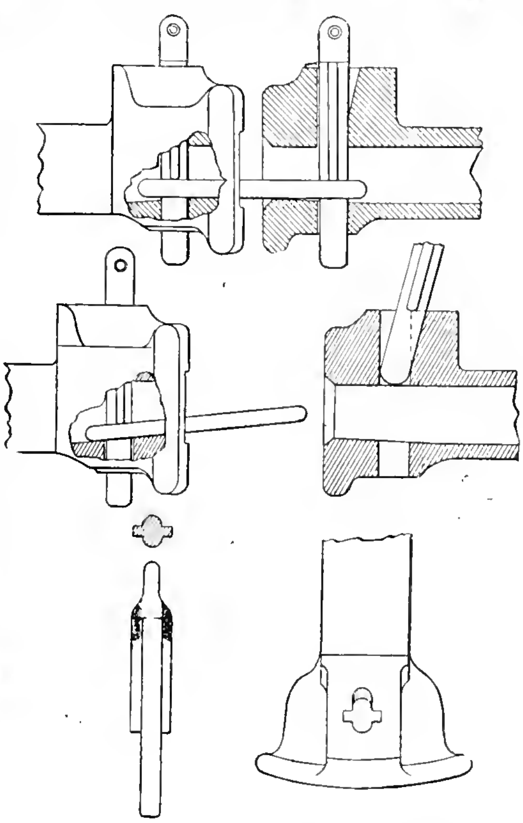

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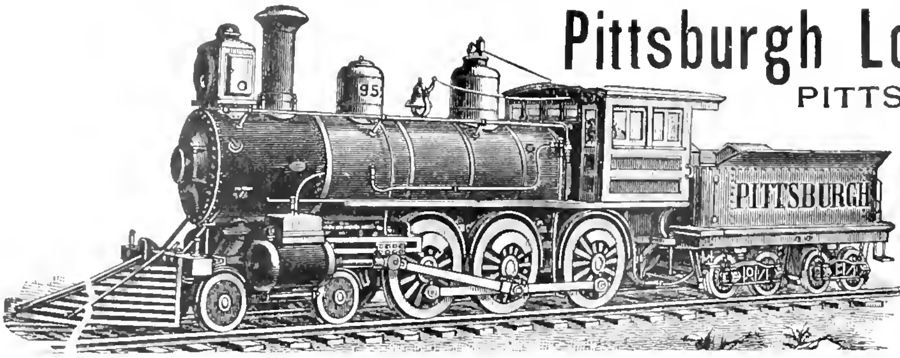

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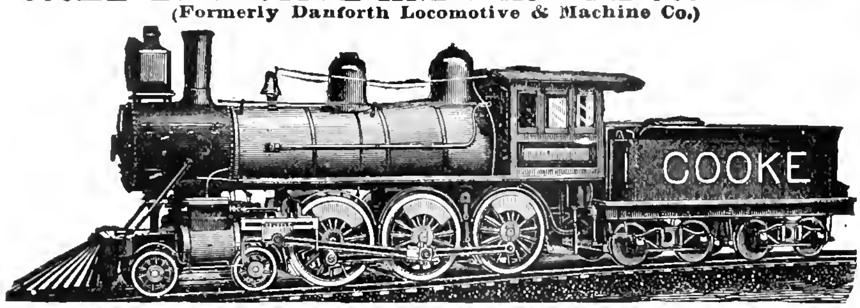

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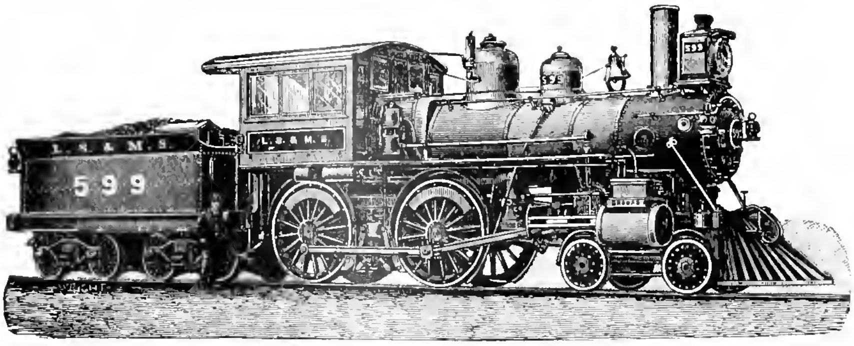

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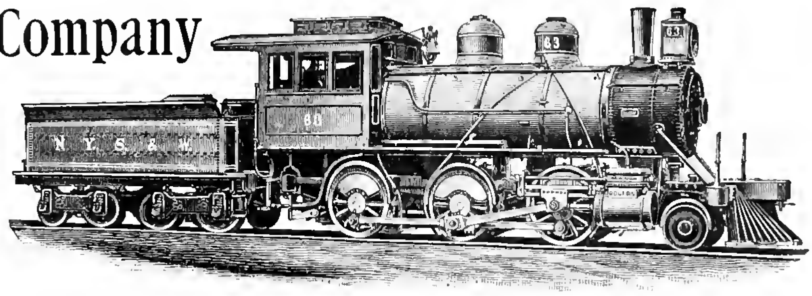

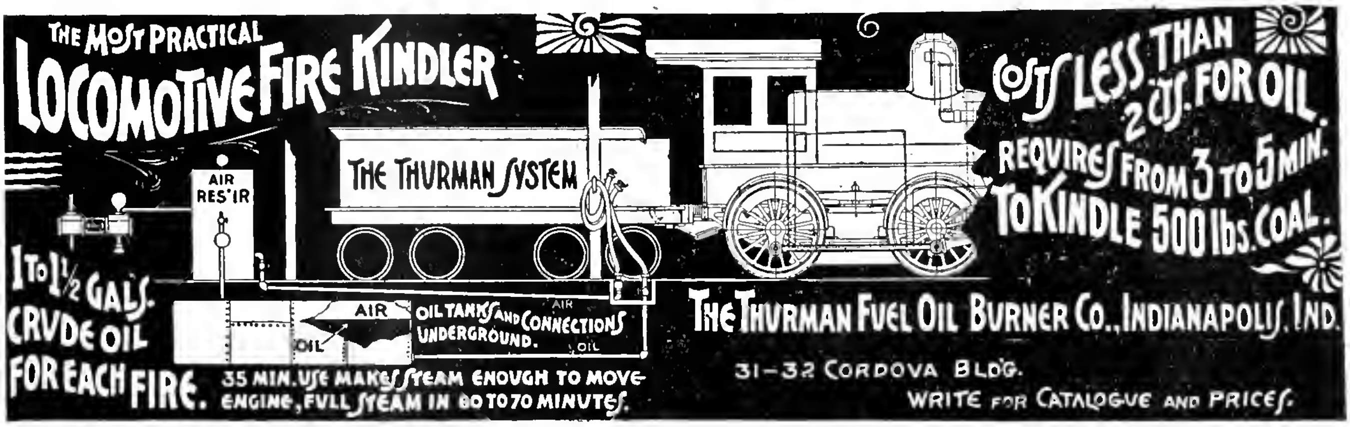

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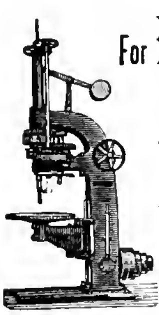

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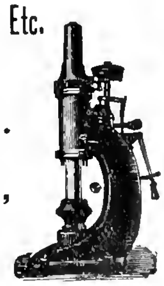

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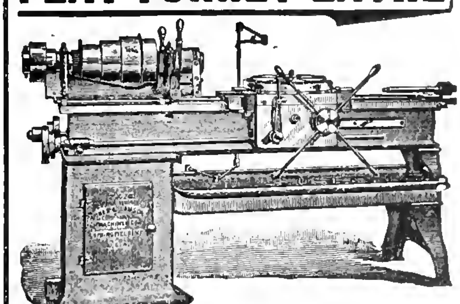

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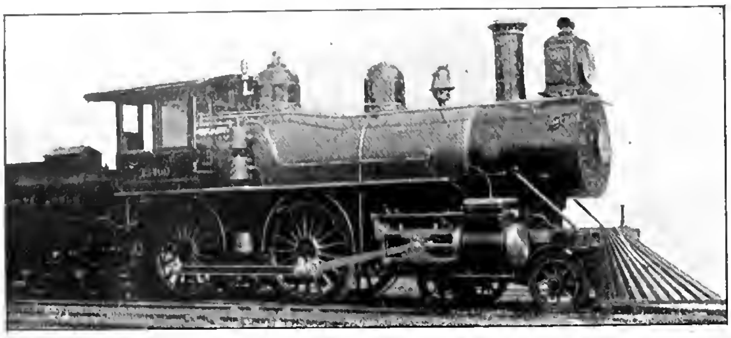

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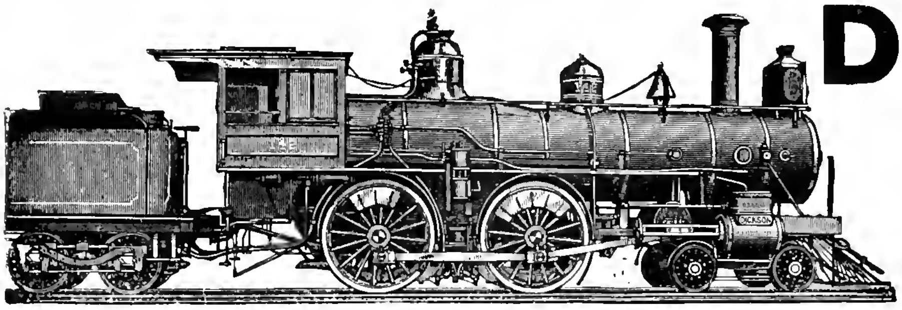

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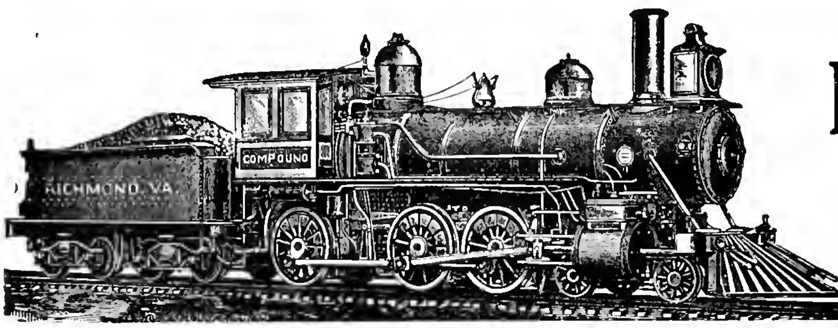

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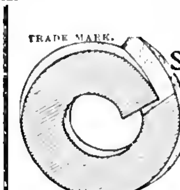

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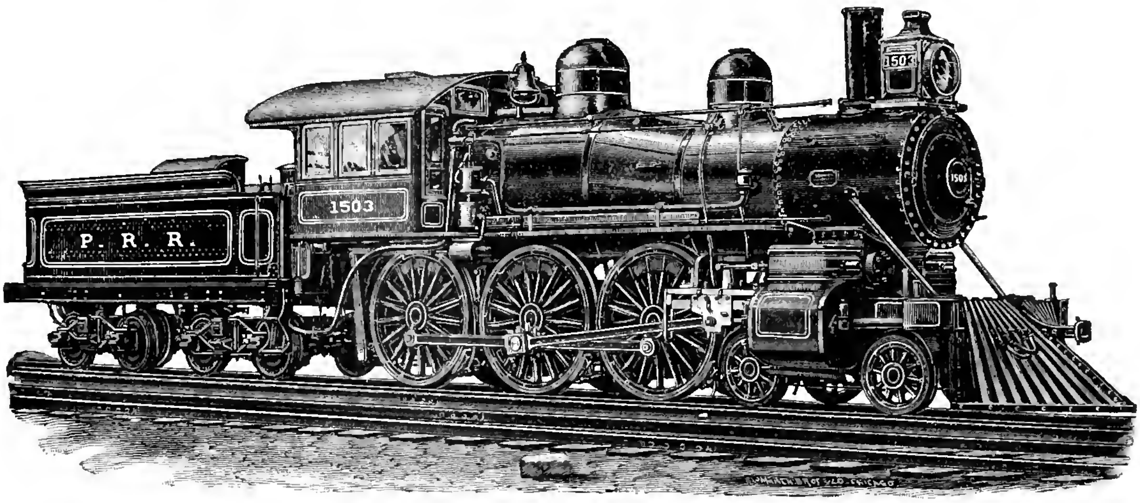

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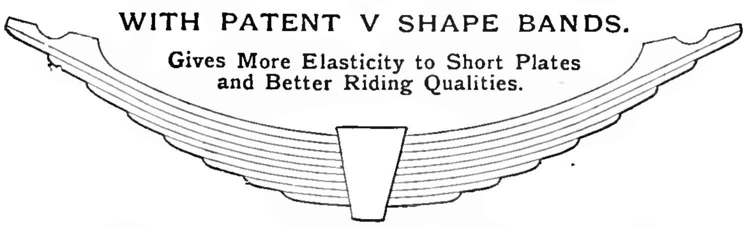

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Vol. VIII. 256 BROADWAY, NEW YORK. No. 8.

The 1895 Class "P" Express Engines for the Pennsylvania.

The Juniata shops of the P. R.R., at Altoona, have just turned out seven new eight-wheelers that are improvements over the class "P" engines of former years.

Our engraving shows the general appearance of these engines. They are fine-looking and fine-working locomotives.

Particular attention has been paid to getting them handy and comfortable to the men in the cab. The steam and air gages are on a bracket on the corner of the Belpaire firebox, and facing the engineer, who is seated at the corner; the engineer's valve is just below them, and the reverse lever ahead of the runner, on the side of the boiler. The throttle stem enters the head and a lever is carried up to top of boiler, which is actuated by a crank on a shaft; this shaft runs to the engineer's side of the boiler, and the throttle lever is keyed to it; this lever hangs straight down along the boiler side, and the end is turned out for a handle, having a ratchet latch. Everything is within easy reach of the runner. The lubricator is on the left side, and the feed must be looked after by the fireman.

The boiler has a 62-inch ring at the smokebox, then a course that is a frustum of a cone, enlarging to 68 inches; back of that there is a straight 68-inch course, carrying the dome, and behind that a Belpaire firebox. This is 60 inches wide at the rear and across the entire top, the sides being rounded out in front to the size of the shell, and this bulge runs out to the flat at the rear; this gives more room at the rear in the cab.

The firebox is 120 inches long and 41½ inches wide, fitted for anthracite coal. There are 310 flues 1⅞ inches diameter.

The cylinders are 18½ x 26 inches; the valves have a 6-inch travel, 1⅛-inch lap outside and ¼-inch clearance inside. The ports are 20 inches long, 1⅜ inches wide. The drivers are 80 inches diameter, of cast steel.

A Dean crosshead is used, but made of two pieces instead of three.

The links, hangers, etc., have forged cups where ordinary oil holes are generally used.

The jacket is steel, painted black, and adds much to the "business" appearance of the engines.

These engines are minus several Pennsylvania ear-marks; they have sandboxes on top of the boiler, and are minus the alligator crossheads and guides.

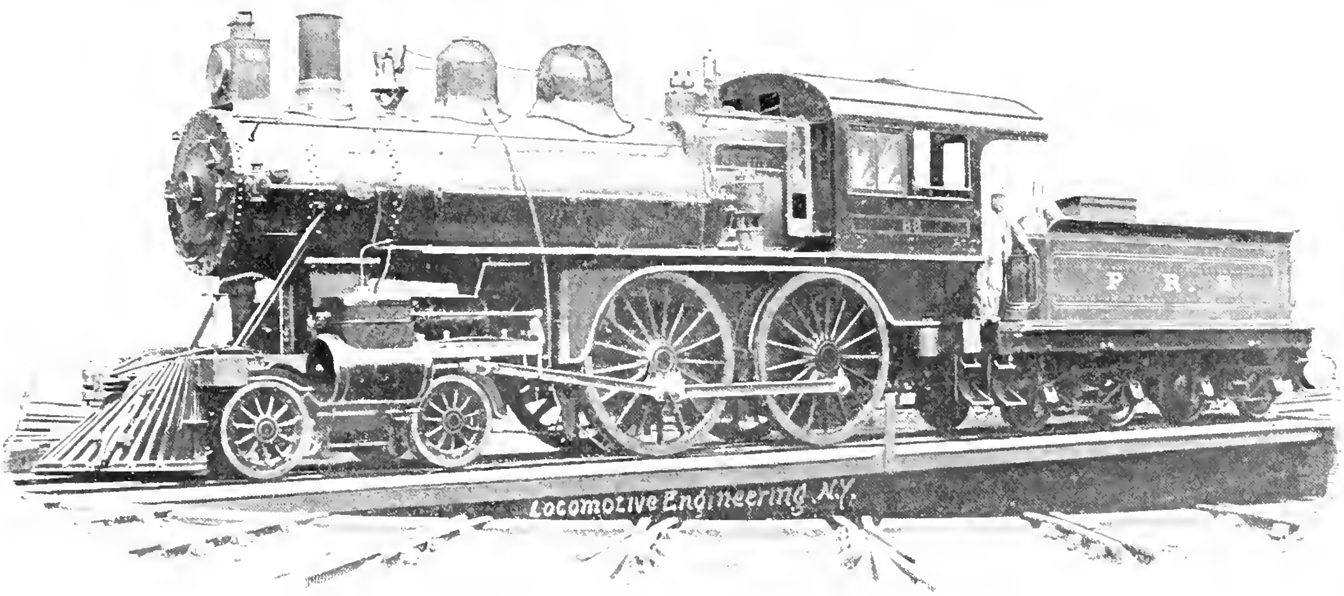
The smokebox door has inside hinges on a swinging link, and is bolted up tight all around outside.

The pistons are fastened into crosshead by a split nut, the end of piston being shaped like an axle, the nut surrounding it and forcing it into crosshead.

There are no back boards in the cab; it is open, like an eight-wheeler, and the men can see and converse with each other.

The P. R.R. always make good steps and hand-holds, use inside checks and fasten up their branch pipes against the boiler better than any other builders.

The new engines carry 180 pounds of steam pressure.



NEW CLASS "P" EXPRESS ENGINE, PENNSYLVANIA RAILROAD.

The makers of locomotives have met and stiffened up the prices, steel rails are two dollars a ton higher than they were a month ago, wages have increased, the crops are above the average, business is picking up, and it looks as if we might do a little railroading again this fall.

∴ ∴ ∴

It is said that the machinists working under the piece-work system at the Panhandle shops at Columbus, O., make from $90 to $120 per month, and are more than satisfied with the work, as the prices are not altered for every improvement made by the men.

Apathy About Coal-Saving.

A speaker at a meeting of railroad men recently remarked, that if railroad companies would pay half as much attention to saving coal as they devote to the saving of oil, the fuel bills would be reduced 25 per cent. This may be putting the case rather strongly, but it is certain that there is in some quarters intense activity in the interests of oil-saving and almost apathy towards the quantity of coal burned. For a long time this was a puzzle to us, since it seemed to be another case of plugging the spigot and opening the bunghole, but careful investigation has brought more light upon the subject. There is no uncertainty about the quantity of oil delivered to locomotives. It is all carefully measured and an accurate account kept. The quantity received is beyond dispute. The casks or tanks can be measured or gaged, and the whole supply can be intelligently accounted for. Therefore, when a saving of 10 or 20 per cent. is secured, the extent of that economy in supplies is beyond question. The expenses for oil have been materially reduced, and no one is inclined to raise doubts concerning the truth of the figures.

With coal the case is different. There is remarkable looseness about the records of the weight of coal delivered. A car is said to contain a certain weight, but in very many cases the quantity is a rough guess, with a tendency to favor the consignor. When the storage sheds are filled, a certain reputed weight of coal has to be accounted for, and the greater part of it must be charged to the locomotives. All stealings and a variety of causes for shortage are made good by extending the charge to locomotives that have not used the coal. The consequence is that an impression has grown up that it is impracticable to tell within 10 or 15 per cent. of the exact quantity of coal burned by the various locomotives. This is enough to freeze up all zeal for coal-saving. The more conscientious a railroad officer is the less inclination he has to effect saving when there is no certain record of the results achieved. This is why the inventor, who offers an improvement which is calculated to save from 10 to 20 per cent. of fuel, is received with so much apathy. No one can tell with any certainty whether a saving has been effected or not.

A reform that is more needed than any other is an improvement in the methods of handling the coal for locomotives. There is nothing more conducive to waste and to careless habits than the practice of guessing at the weight of coal placed on tenders. This is aided and abetted by the practice of spreading shortage over the list of locomotives that have been served at the points where the shortage took place. While loose habits of this character remain in vogue, there will be no proper appreciation of the saving that would accrue to railroad companies from the introduction of improvements calculated to reduce the consumption of fuel.

The Price of Crude Oil for Fire Kindling.

This subject came up at the last meeting of the Master Mechanics' Association, when one superintendent of motive power requested the committee to inform the assemblage where oil could be purchased for two cents per gallon. One man stated that it was worth from seven to nine cents. These members confounded crude oil in tank cars with lubricating oil. Although Mr. Bushnell, of the B., C. R. & N., stated that he bought it for less than two cents, there seemed to be some not quite ready to accept the figures. We have just received word from Mr. Geo. F. Wilson, superintendent of motive power of the C., R. I. & P., who uses oil for fire kindling exclusively, stating that they have never yet paid over 1.71 cents per gallon for oil delivered in Chicago, and are paying that price at the present time.

* * *

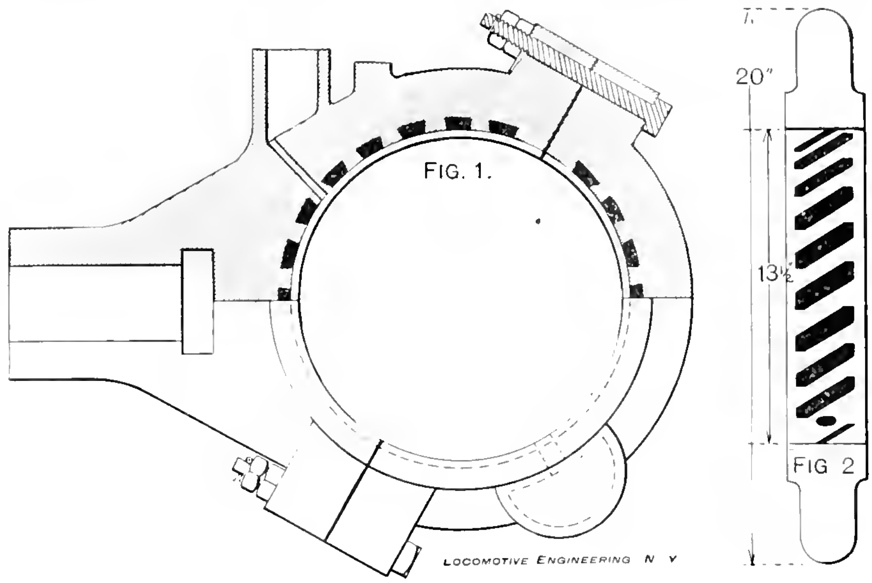
Look out for the colored plate of ten-wheeler next month. It will be worth a gilt frame.

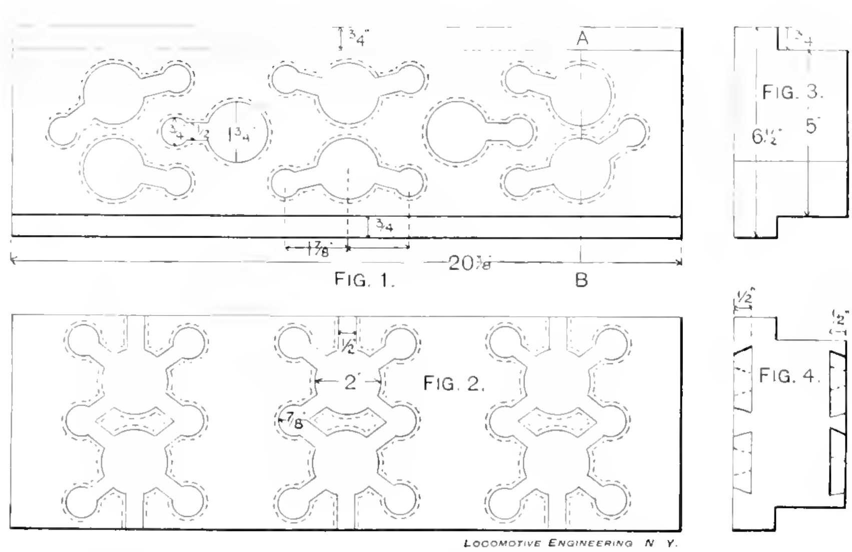
More Plans for Saving Machine Work.

Continuing the subject of economizing by hunting up work that can be avoided in running repairs, we would call attention to the sketch here shown of the engine-truck axle box used on the Missouri Pacific.

No part of this box, bearing or cellar is machined in any way. The pattern is carefully made; all the oil holes, cellar bolt holes, etc., are cored and made in the casting. The sides have a dovetailed recess on top and sides, as shown in Fig. 1. These are filled with babbitt, hammered in and trimmed off. The recesses are cast on both sides of the box, so that it can be turned to take up side motion. The steps or pockets for equalizer ends are cast with the bottom crowning to bring the bearing in center without fitting of box or equalizer end.

The brasses are cast solid and lined with babbitt on a former $\frac{1}{8}$-inch larger than the axle—this to insure a good crown bearing. The cellar is cast, being a loose fit sideways and resting on lugs on the sides of the box, as shown; on the bottom of cellar is cast a projection that extends below the cellar bolt and prevents cellar from coming



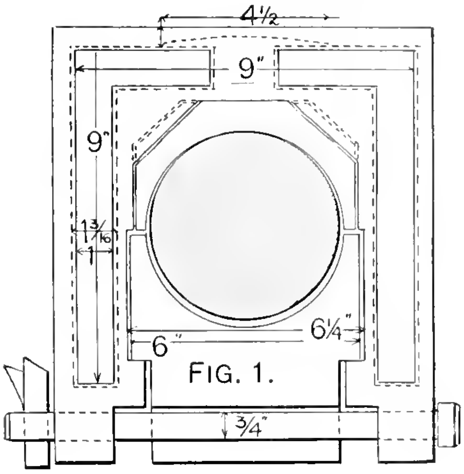


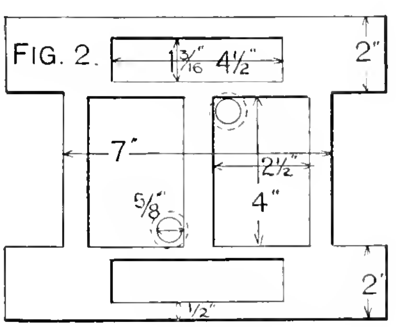
out. A single cellar bolt is used, cellar-bolt holes cored out.

An engine-truck box can be and is fitted up for the road in twenty minutes, and the M. P. people do not hesitate to put these boxes out new on their fast passenger engines. They can't cut anything; all bearing surfaces run on babbitt.

The sketch of eccentric strap shows the standard strap lined with babbitt hammered into cast recesses before turning. No work done on straps, except to bore out. They claim a radical cure for all hot eccentrics in the use of babbitt, but say that to insure results the babbitt must extend entirely across the bearing surface.

The sketch of the babbitted cavities in





LOCOMOTIVE ENGINEERING, N. Y.

crosshead gibs shows the plan used for top and bottom. This coring looks elaborate, but it must be remembered that it is only done once—by the pattern maker—and is made in the form shown to cause the shrinking metal to draw itself tight on the tapered cavities. Crossheads are planed off after babbitting.

The Denver & Rio Grande R.R. Co. have put a 3-inch tire on one of their consolidation engines, over the old tire, which makes a 6-inch larger wheel; old wheel was 44 inches. This engine hauls the same trains as before, and makes as good time up hill and better time down hill, and runs lighter on coal and oil. With the smaller wheel, engine lost considerable power slipping, which is reduced somewhat with the larger wheel.

Jim Skeevers' Object Lessons.

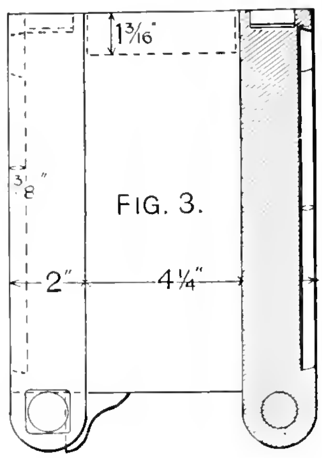
How to Scarf Flues—Great Inventions That Can't be Patented.

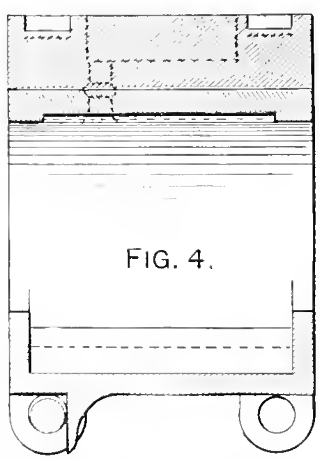
John Massey is home again, and Jim Skeevers is only foreman of the shop to shop men, and plain "Skinney" Skeevers to the engineers.

Massey and the "old man" took a walk through the shop the other day, and were clear out in the boiler shop before they ran onto Skeevers; that hearty was testing some flues that had just been safe-ended, by pounding the welded end on the floor.

"Skeevers," said the "old man," as he cut off a mouthful of plug, "are you working up one of your object lessons?"

"Well, yes, sir; sort of a limited one."





"Where have you put that scarfing machine, Mr. Skeevers?" asked Massey, looking up at the holes in a girder and the dirt, where a countershaft used to be.

"Outside there by the scrap bin."

"Outside! Why, man, I only got that running a few days before you took holt here—you ain't stopped usin' of it?"

"Yes, I think I have found a better scheme—I'll show you how it works."

As Skeevers moved away toward the flue welder, the general master mechanic dropped back with the general manager and remarked:

"That's a shame. You remember how I showed you the way the scale prevented a good weld when the scarfing was done hot, and that you approved my home-made tool to *cut* the scarf—'cause we always have clean metal to weld. Don't you remember?"

"Yes; 'pears to me I do."

"And now this loonytic has throwed the scarfer away—and it cost three hundred dollars."

"Say, Mister Skeevers," said the "old man," "did I understand you to say you had thrown the scarfing machine away?"

"Yes, sir."

"What for?"

"Let me explain *after* you see the way we weld the tubes now—think I could make it plainer then."

"All right, sir."

Skeevers stopped before several sets of flues standing on end along the wall, and, selecting one, gave the stone floor a smart rap or two with the "safe" end, breaking it off through the weld.

"That," said Skeevers, picking up the piece, "is one of a set of flues welded before the scarfing machine was made—a set too short, been up at Granger for a year. You see that the welded joint is very thin; half the metal did not join, and looks black. Now, some of these do pretty well, but in time give out, causing trouble. Mr. Massey looked at some of the broken welds, and came to the conclusion that it was scale—it certainly looks like it. Now, he sought to cure the trouble by furnishing clean metal at the welding point, and he got it with the machine toggled up out of an old bolt cutter. Now, this next set was welded up last month, using the cut scarf ends."

Skeevers broke one as before.

"Pretty fair job, but you see that the weld looks just the same as the old one. The welded joint is not more than half as thick as the tube. Looks as if there was scale in there yet, don't it?"

Massey looked at the safe end; the "old man" put on his specs, and gave it a careful inspection.

"Break another one," ordered Massey.

Skeevers took down one, and it required several blows to break it, but it finally broke in the weld.

"Pretty good job that, as welds go, but it broke in the weld, and it looks the same, Mr. Wider."

"So it does, so it does."

Skeevers looked at Massey, but that worthy had fished up a pocket magnifying glass and was looking very wisely at the break.

"Now," said Skeevers, modestly, "I got to thinking about the trouble we have had with safe ends, and the result is that I defy you to break this tube—selecting one from another set—in the weld."

Skeevers slammed the welded end on the floor time and time again without other effect than to batter the end, then he put it in a vise and, with help, bent the tube—but not in the weld.

"Beats the devil, don't it, John?" piously remarked the general manager. "How do *you* scarf 'em, Skeevers?"

"Don't scarf 'em at all."

"Thunder and ——!"

"Watch that weld being made there," said Skeevers.

The workman took a flue out of the furnace, knocked the hot end on the anvil to clean it of the scale, slipped it onto the mandrel under the little trip hammer and the other end in a V notch, made to receive it, the end itself resting against a post. His helper brought a safe end from the same furnace at the same time, knocked the scale off, slipped the hot end over the mandrel and gave it a smart rap or two with a heavy mallet. The workman put his foot on the belt tightener, and the little hammer played a tattoo on the flue as the smith turned it over once or twice with his hand.

"That's jumping 'em on," observed Massey, "and any mechanic knows that a 'jumped' weld ain't no good."

"That all depends on what you've got to 'jump' and the conditions of the heated parts. Now, if you take a 1-inch rod and a 1½ rod and put 'em in the fire until one of 'em is at welding heat, which one will get ready first, Mr. Massey?"

"The smallest will."

"Just so. Now, nine chances to one if you leave 'em both in till the big one is ready to weld, the little one will be burnt. If they are both the same heat—dripping hot—a 'jumped' weld, as you call it, is just as strong as any that can be made—stronger, in fact.

"Now, your scarfed tube and safe end has a sharp edge, and that edge gets hot first, and is burned when the body of the tube is hot enough to weld. What's the result?—a bad weld, looks like scale, but it's burned material.

"With a butt weld, the material of the tube and the end are of the same size; we heat them in the same furnace, to the same heat, and make a perfect weld. Cut one of those tubes in two, and you will find the metal clean and solid clear through, and a little thicker than the tube—that is on account of the mandrel, and explains why you can't break the tube in the weld. I'll give you a dollar for any tube there that you can break in the weld."

"Then the scarfer is no good?" asked the old man, passing a sly wink to Skeevers.

"Just the same as winter before last's overcoat—you don't need it *now*."

"Well, that's an object lesson, John," said the old man, "kinder of a litter of 'em. Firstly—Old prejudice against hoppin' welds is dead wrong on flues. Secondly—Scarfin' machine no earthly account where you don't want to do any scarfin'. Thirdly—Thinkin' about a thing is important. Fourthly—Thinkin' in the right direction is more important. What's the use of thinkin' up a scarfer, when you can just as well think up a plan to stop scarfin' altogether—say?"

Massey wandered on to a fire where they were making grab irons by the cord.

"Say, Skeevers, darned if that wouldn't be worth a patent; I'll go halves with ye. Lemme see; what *do* you do? *Don't scarf flues for weldin'*. Hum!—why say, Skeevers, you can't get a patent for *not* doing something, not if it saved a thousand dollars a minute, could you now?"

"Well, hardly; I did think I was original in that till day before yesterday, when a drummer for a boiler plate company came along and I showed it to him.

"'Why,' sais he, 'Skeevers, old boy, that's old—way back yonder. Why, man, you couldn't get Bill Tyler to weld a flue any other way, and he's been in the business so long that he's some relation to half the flues you see around the country. The Government specifications call for butt welds—where have you been for the last ten years, anyway?'

"Give me a lot of chaff like that, but he owned up that he never heard of a railroad welding tubes that way, but said, 'What's the use of telling these ducks anything, anyway? They never go around to see other things, and they feel sorry for everybody in the world 'cause they don't do work as they do.'"

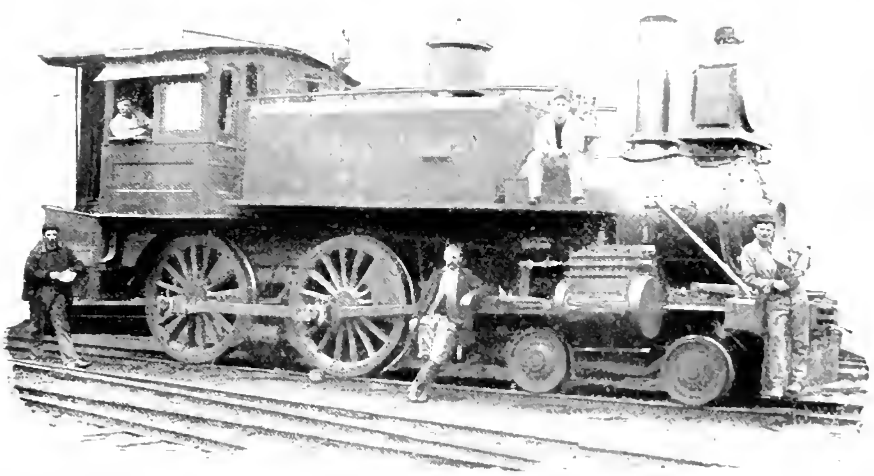
"John," said the "old man," as they caught up to Massey, "if you've got such a thing as a note-book with ye, just put down in large, red letters, '*Jumpin' welds is the stuff!*'"

"Say, Skeevers," he added, "couldn't ye work that scarfer off on Davis for a lathe or a lean-to, or a chimley, or something?"

Getting Even With Firemen.

"It is a well-known fact," remarked a master mechanic, as we were exchanging experiences at the convention, "that there is not a tenth of the difference in the engines of the same size and build as there is in the engineers. In spite of all that has been done to impress upon engineers the fact that their first duty is towards the company employing them, many men will let small personal considerations have much more weight in regulating their handling of the engine. One man has a spite against his fireman and will drop his link down at a critical point when he knows the fire is light. The result is he turns it over and has a case for ridicule against his fireman. He talks about it at the end of the run, to put his fireman into disrepute with the heavy shovelers, who give no engineer the opportunity to turn over their fires. This has an evil effect upon the business, and puts the conscientious man trying to do his work properly at a disadvantage. When I have a report of delay from a fire being turned, I lay off the engineer.

"Other engineers are afflicted with a zeal to save their valves, and to do so they run the engines cutting off at half stroke when the work could be done as well at quarter stroke. We had an epidemic of trouble several years ago between the engineers and firemen on account of some Brotherhood matter, and the coal consumption increased very rapidly. We were at first inclined to put the blame on the firemen, but a quiet inquiry brought out the fact that the engineers had been overcome with a sudden zeal for saving their valves. They had all become hard hitters as a means of getting even with the firemen in a dispute in which the road had no interest. Our getting on to the game put an end to it."



A Veteran—Old Eight-Wheeler, in Service for Forty-six Years, Fall Brook Railway.

Every now and again we receive questions from correspondents who want to know why American railroad companies do not use copper fireboxes, and obtain from that material the durability that copper fireboxes yield in other parts of the world. In reply to this we would say that copper fireboxes have been thoroughly tried in this country, and that it has been found that they give rather less service than good steel. In this respect, it is not the American locomotive builders who are behind the times, but the people abroad who persist in using an expensive material which is much weaker than steel, much more given to failure, and much higher in first cost. The reason why this is thus, is that foreign engineers have not learned the art of making good steel fireboxes.

BLOCK SIGNALING

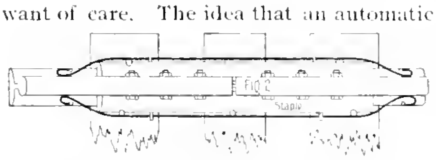
Installation and Care of Automatic Electric Signals, with a Comparison of the Cost of the Different Block Signal Systems.

By W. H. ELLIOTT,
Signal Engineer,
C., M. & St. P. R.R.

[EIGHTH PAPER.]

As automatic electric signals are coming into such general use, and as the number employed in looking after them increases, it may be well to give some of the few points learned by me in a somewhat limited experience regarding the installation and care of these signals, in the hope that some of the readers of these articles may be benefited thereby. Automatic electric signals when first installed are generally found to give excellent service, and the officers of the road congratulate themselves on having secured such a "good thing." Very soon, however, reports come from enginemen that certain of the signals were found standing at danger improperly, and upon an investigation being made, it is discovered that the trouble is occasioned by a want of care. The idea that an automatic signal will take care of itself for an indefinite length of time has done much to make such signals unpopular, when it is found that they require to be more carefully looked after than any other kind. Not only must the work be well done and regularly attended to, but the men employed must be intelligent and willing to learn, for there will be many things turning up that will perplex the most experienced.

GOOD METHOD OF ATTACHING WIRES TO A RAIL.



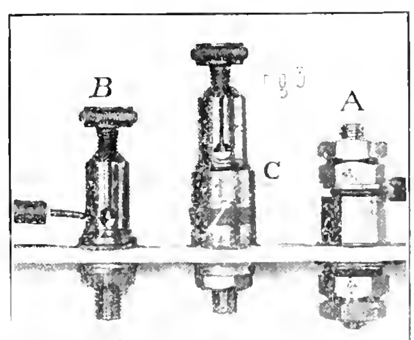
BOND WIRES AT A RAIL JOINT.

In the first place, there are so many things that can happen to an electric signal that will throw it out of service that no chances can be taken in the installation, but everything must be of the best that money can buy, and the work must be as nearly perfect for the end in view as it is possible to make it. It will be true economy in the end, and will result in making the signal a success where most probably it would have been a failure had less care been taken.

In installing a track circuit system, one of the most important points to be looked after is the joint or connection that is made between the wires of the circuit and the iron wires joined to the rail. These, as indeed with all of the other joints, must be soldered, but, as one wire is of copper and the other is of iron, particular pains must be taken to make a good joint and to protect it after it is made. A good way in which to make this connection is to strip the copper wire of its insulation for about 12 inches, twisting it separately around the ends of the two iron wires that are joined to the rail, and then soldering each joint thoroughly. In this way two entirely separate joints are made for the one connection, and it is very probable that if one should rust out or break, the other would be good and the circuit would be maintained. After soldering, the joints are to be washed and dried to remove all trace of the acid used to solder with, and should then be painted with a good coating of P. & B. compound. Asphalt paint is not so good for this purpose, as it soon cracks, and will not then keep out moisture. The joints should next be taped with insulating material, and wrapped in canvas covered on both sides with P. & B. compound to make the cloth thoroughly waterproof, after which the whole is put in a wooden box or trunking and buried in the ground, the end of the trunking being brought up above the surface, as shown in Fig. 1, to keep the bare wire from coming in contact with the ground.

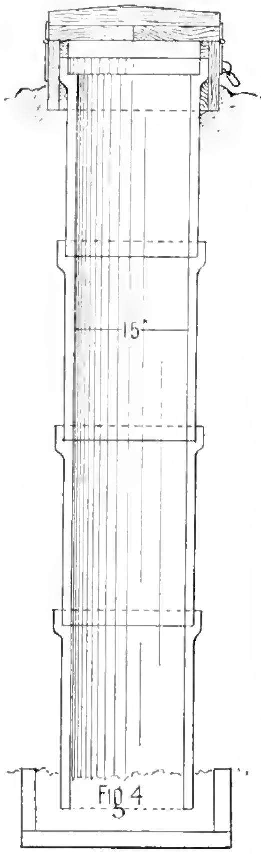
It will be noticed that the wires, after reaching the rail, extend along it for a foot or more, before being fastened. This is done to prevent the wire from being broken from the jar of the rail caused by a passing train, as making the wires long in this way allows them to spring, instead of being bent, when the rail is deflected.

There are two ways in common use in which the wires may be attached to the rail, each one being controlled by one of the signal companies. That used by the Union Switch & Signal Company is to solder the iron wire to a rivet, which latter is driven in a hole drilled in the base of the rail. The wire leads off at right angles to the rivet, and there is no necessity for bending it, other than to clear the angle bar, when used as a bond wire at rail joints. The other is that controlled by the Hall Signal Company, and is to fasten the wire in a hole drilled in the rail by a tapered plug, having a groove in the side in which the wire is held. With this latter method care must be used in giving the proper set to the wire, or it will be apt to break if a bend is formed at the sharp edge of the hole. To prevent this, the wire must be left straight for about 1/4 inch above the rail, before bending, to bring it parallel with the base of the rail.



BINDING POSTS.

There is quite a difference in the practice in regard to the best way to run the bond wire around the angle bars at a rail joint, but that shown in Fig. 2 will be found to be a very good one. The wire is made longer than the distance between the plugs, to allow for a separation of the ends of the rail from contraction or creeping. Running the wire on the tie does away with every chance of breaking or even bending the wire, when tightening up the track bolts or removing angle bars. A staple driven over the wire into the tie holds it down, preventing its being bent up and broken.



A Battery Well.

The wooden splices are made of oak, and last a long time if properly put in, otherwise their life is short. As wood, in comparison with iron, is a very soft material, it will very soon become worn if subjected to the blows given a joint by a passing train, so that the only way to make such splices give any kind of service is to support the ends of the rails by a tie placed underneath, or, in other words, make it a "supported joint." The wooden splices are not put in to support the ends of the rails, but to tie them together longitudinally and prevent their spreading.

In laying insulated wires in trunking, they should never be tightly drawn to take out the slack, and whenever a bend is made, or a wire leads off at right angles from the main wire, several inches of slack wire should be left to allow for changes in length due to contraction. In running wires from one signal to the next, it is much the better and cheaper plan to put the wire on the telegraph poles in preference to putting them in the ground. With the former method, while there is the chance of the wire being occasionally broken by storms or from poles falling down, such breakage is easily detected and repaired; while with the latter method it is very hard to locate any break in the wires, particularly if laid in the form of a cable.

On account of the difficulty of detecting breaks and the annoyance occasioned by having a signal fail to work, it is a good plan to use a wire of comparatively large size and covered with good insulation, rather than to use as small a wire as will carry the current without too great a resistance. We are using an insulated wire of No. 14 Birmingham wire gage with great success, and have never been troubled with its breaking after being once properly put in.

With regard to the relay to be used, a great deal of care should be used in selecting one that is correctly designed for the uses to which it is to be put; for, while the wiring up may have been poorly done, it will give good service as long as it lasts; whereas with the relay, if not especially adapted to the work it is to perform, it will not work properly during wet weather, and will be continually giving trouble. Where a relay will not work, there is nothing that a repairman can do, except, perhaps, to have a bulletin notice issued that the signal is out of order; for while the circuit is complete, the relay is not sensitive enough to work with the amount of current that flows through it, the greater part generated by the battery leaking across the track and practically short-circuiting the relay.

There are many things, mechanical as well as electrical, that have to be considered in designing a relay for a track circuit, several of which have been overlooked in one lately put upon the market by one of the signal companies, as an instrument embodying all that is required in a well-designed relay.

The most important point to bear in mind is, that the resistance of the magnet should be four ohms and never more than this; for, as the resistance of a single cell is four ohms and the resistance of the external circuit should not be more than the resistance of the battery (to obtain a maximum effect with an electro-magnet), any greater resistance in the relay is a loss rather than a gain, materially increasing the leakage across the track where the resistance between the rails is low.

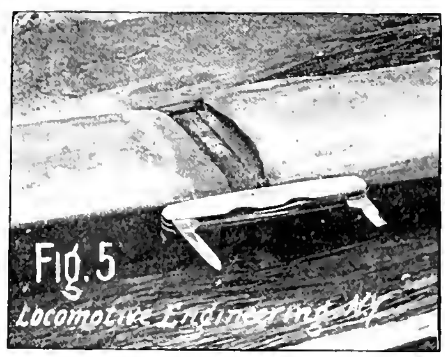
Electricity will always follow the path of least resistance, the amount of current flowing through two parallel channels being inversely proportional to their resistance. With long track circuits, the resistance between one rail and the other is at times, during wet weather, as low as three ohms, or possibly less, in which case the amount of current that would flow through the relay would be but three-sevenths of that generated by the battery, so that the relay must be constructed to work, not with the whole current of a two-cell battery, but with as small an amount of current as is possible to make it work.

Having decided on the resistance to which the relay is to be wound, the next point is the length and size of the iron core, for this will affect the amount of magnetic force, or the lifting power of the magnet for a given amount of current.

The value of any current of electricity for producing magnetism in an iron core is proportional to the strength of the current and the number of times it circulates around the core, or, as it is expressed technically, the number of ampere turns. The problem, then, is simply to get the greatest number of turns around the core with an amount of wire that does not exceed the given resistance. This requires that the core be long, so that there will be room on which to wind the wire, and small, so that there will be less wire used in making one turn; but as the number of ampere turns that will magnetize a thin core to any prescribed degree of magnetism, will magnetize a core of any section, whatever, to the same degree of magnetism, it is advisable that the core must also be made as large as possible, commensurate with a given number of turns, the power of a magnet for a given degree of magnetization being proportional to the area of the core.

If the core is made small, the intensity of the magnetism will be greater (the number of turns being larger), and the leakage across from one pole to the other, or the loss of magnetic force, will be much greater. This being the case, there will be a much greater efficiency if the core is made large, and also long enough to furnish space on which to wind the wire, for the wire must be made large to give the greatest number of turns with the given resistance. Practice has demonstrated that a core $\frac{3}{4}$ inch in diameter and 4 inches long, wound to 4 ohms resistance, gives a much better and more satisfactory result than will one of $\frac{3}{8}$ inch diameter and $2\frac{1}{2}$ inches long, wound to the same resistance with smaller wire.

Taking up now the question of the proper construction of the armature, we find that as the piece of iron is not in actual contact with the pole pieces of the magnet, considerable resistance is introduced into the magnetic circuit, the number of magnetic lines of force, and consequently the pull, being decreased in a proportion slightly greater than the square of the distance the armature is away from the poles. This being the case, to obtain a maximum magnetic pull from a given amount of current, the armature should be



Knife Magnetized and Held Up by Induced Current Flowing from One Rail to the Other.

made to work as close to the poles as it is possible to make it, and all the parts should be made to admit of very careful and accurate adjustment.

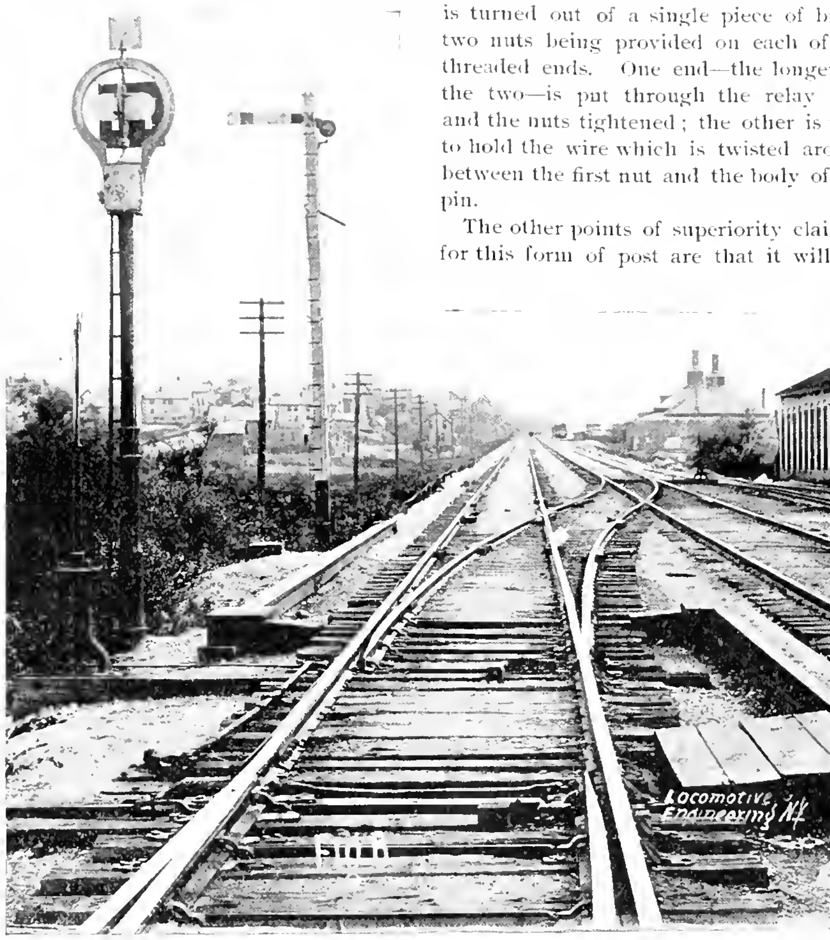
To secure a close adjustment of a relay armature, the ends of the shaft to which the iron piece is fastened must be pointed, and the pivot screws or bearings must be cap-shaped, so that perfect freedom of movement without loss of motion may be obtained. Where the pivot screws are turned down and fit in a hole drilled in the armature frame piece, it is impossible to make a close adjustment, as from the nature of the work the pin must fit loosely in the hole, and there will be just that amount of lost motion at the armature. If the holes are made almost $\frac{1}{32}$ inch large, as will sometimes be found in relays of this construction, it is seen that the armature cannot be adjusted much closer than $\frac{1}{16}$ of an inch, as it is necessary, when breaking the signal circuit, to separate the contact point at least $\frac{1}{32}$ inch, the spring of the arm carrying the point, allowing the armature piece to make, practically, the same amount of motion. The armature should be arranged so as to allow for positive adjustment at both ends of its stroke; the arms carrying the contact points preferably being made of spring metal, which will bend slightly when the points are brought together, and make a slight rubbing contact, thus tending to keep the surfaces clean and be more certain of making a metallic contact.

In designing the armature, care must be observed to see that the pull of the magnet is applied at a point between the contact points and the center of gravity of the whole piece, or else the pivoted end will be lifted first, the points being brought together only after the whole armature is lifted. With a weak current, such a fault as this will mean that a relay that otherwise would have been able to do its work will fail to lift the armature, and there will be nothing that a repairman can do to fix it, except, perhaps, to tilt the relay and thus lessen the force of gravity—a thing which is sometimes done with the form of relay alluded to, but which should not be so placed, from the possibility that the armature will not fall back and break the signal circuit and put the signal at danger when a train is in the block.

The iron forming the armature should have a piece of paper cemented to the side that is next the pole piece of the magnet, to prevent the two pieces of iron from coming into actual contact with each other. This is done to prevent the armature from sticking on account of polarization, or the residual magnetism that is left in the iron, as iron after once being magnetized will retain sufficient magnetism after the circuit is broken to hold the armature, if the two pieces are in actual contact.

Paper is better than a thin piece of sheet copper soldered to the armature, as it is lighter, and is also much better than pieces of rubber, brass or other non-magnetic material driven in a hole drilled into the end of the core and left projecting above the surface, as the two surfaces have to be separated much further than with the paper, from a possible tilting of the armature bringing it in contact with the pole piece of the magnet.

To provide the relay with fuse contact points, as they are called, one of them being pointed so that it will fuse and stick to the other if a current somewhat larger than is intended should be introduced into the circuit, is a very bad plan, as the two points would then not separate when a train entered the block, and the signal would not be set at danger.



View Showing Location of Switches Where Potential of Induced Current is Highest, and Where Current Leaks Across the Insulated Joints to a Grounded Dead Section.

Another very important point to be looked after in constructing a relay is the inclosing of the contact points, so that no dust or other substance will be allowed to get between them. Dust, being a non-conductor of electricity, will prevent the points from making a contact, and the signal circuit will not be completed when the armature is lifted by the relay, the signal, in consequence, remaining at danger. With relays of the ordinary pattern, not made with the idea of inclosing the points, a cover that is perfectly dust-proof can be easily made by removing the bottom of a hardwood box and gluing strips of chamois skin on the edges, the box to be placed over the whole relay, and screwed down to make a tight joint with the board supporting the relay by means of screws run through brackets, which must be provided for the purpose on the outside of the box.

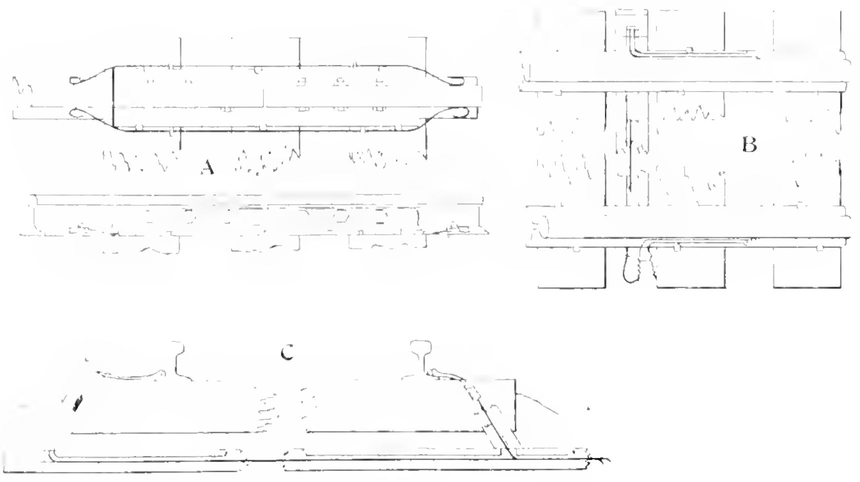
Binding posts are another important feature in the construction of a relay, and one which, unless properly made, will give a lot of trouble. There are several designs, only one of which I have found to work well—that is to say, that will not work loose after being once screwed up, and yet will be easy to unscrew. This binding post is shown at *A*, in Fig. 3. It is turned out of a single piece of brass, two nuts being provided on each of the threaded ends. One end—the longer of the two—is put through the relay base and the nuts tightened; the other is used to hold the wire which is twisted around between the first nut and the body of the pin.

The other points of superiority claimed for this form of post are that it will not cut or kink the wire, making it liable to break; the threads are not easily stripped, and it is cheaply and easily made. To put binding posts in a relay base without providing jam nuts, means that they will have to be tightened every now and then, and that they may at any time work loose sufficiently to break the circuit. Vulcanized fiber washers should not be used to insulate the binding post from the relay base, mica being much preferable, from the fact that it is hard and non-compressible, and will thus keep the binding post from getting loose in the relay base.

To expect that the thumb-screw of a binding post made as is the one shown at *B*, in Fig. 3, will remain tight after once being "set up" on a wire, is expecting more than it will do, for it will certainly give

trouble sooner or later. The objection to this form of screw is that when the post is slotted, as seen in the figure, there is not sufficient strength or spring in the two sides to hold the screw and prevent its working loose from the jar occasioned by passing trains.

To make a binding post of two pieces of metal screwed together, with a piece of insulating material between, so that a fuse wire can be used to connect the two and thus form a lightning arrester, as is shown at *C*, in Fig. 3, is certainly not a good plan, as the wire is poorly held, being merely hammered into a groove cut in the outside of the post. If it works loose or rusts through, as will sometimes happen, the trouble will, very likely, be hard to locate, and if, in setting up the thumb-screw, the two pieces should be screwed together a part of a turn, the fuse wire would be broken. A lightning arrester can be easily made by putting a short piece of fuse wire in the circuit, long wood screws provided with three copper washers and screwed into the sides of the relay box being used in place of binding posts, the ends of the wires being placed between the washers and the screw set-up.



A C., M. & St. P. Ry. standard track wiring.
B Wire connections to be made as near the middle of rail as possible. Joints, after soldering, to be washed, dried, painted, covered with Okonite tape and wrapped with canvas soaked in asphalt.
C Where two or more Okonite wires are in the same piece of trunking, they must be carefully laid so as not to cross one over the other.

As to the care of an electric signal, the part that will require the greatest amount of attention and the one that is most likely to give trouble is the battery. The resistance of the circuits being comparatively low, the consumption of the zincs is rapid, a thick scale of zinc compounds forming which, unless scraped off, will greatly diminish the amount of electricity generated. Again, if the top solution, the sulphate of zinc or the waste product of the cell, is not taken out regularly and the cell refilled with water, chemical action will be retarded and the amount of electricity given off will be less. Consequently, to keep the battery up to anywhere near its maximum output, the cells must be constantly looked after and cleaned. If provided with enough sulphate of copper in crystals in the bottom of the jar, the cells will go without touching for a period of three weeks, but by using a larger number than that necessary to do the work when in good condition, the length of time between cleanings may be longer, as there will still be enough electricity given off to work the relays.

As the track-circuit batteries are arranged to give a large amount of current and not a current of high voltage, the area of the zinc exposed to chemical action in each cell will materially affect the amount of electricity given off, and, as with the signal-circuit batteries, the size of the zincs makes a less difference, the cells being in series to increase the voltage, it will be found a very good plan to transfer the zincs from the track-circuit battery, when they are partly used, to the battery of the signal circuit, new zincs being used in that of the track battery.

The glass jars will occasionally, and in some cases frequently, break. Why they do so has not as yet been explained, the cheapest jars lasting as well as the most expensive, or even those which have been annealed. Jars often crack without letting the liquid escape; but when the crack extends below the bottom of the zinc the jar should be replaced by another, as the solution may leak out, and, by getting below the zinc, break the circuit and put the signal at danger. A broken circuit in the track-circuit battery will seldom do this, as the cells being arranged in parallel, the current from the other cell will still work the relay unless the conditions as to weather are bad. If, however, a zinc should fall down and touch the copper, it will short-circuit the track battery, the cells being in parallel; but with the signal-circuit battery, as the cells are in series, it will only reduce the number of cells in service by one.

Care must be used to keep the binding posts and the ends of the wires clean, as well as to see that all screws have been set up securely after the cells have been cleaned. The binding posts removed from used-up zincs, if soldered to wires, serve as very convenient "connectors" by which to join the wire of the copper element and the line wire. It is advisable to run the wires in all battery-well elevators the same, and to make all connections between the cells in the same way, so that a man will not be likely to reverse some of them in connecting up the cells, thus reducing the number of cells available to do work by twice the number that are reversed. This has been done through the carelessness of the battery cleaner, and was not discovered until the signal went to danger, sometime after the man had left, as the current was generated for a short time sufficiently strong to work the signal, and thus led the man to believe that it had been connected up properly.

A new design of battery well that will be found to answer all requirements, and at the same time cost a little less than half of what the ordinary wooden well costs, or only $8 put in complete, instead of $20, is shown in Fig. 4. This well was designed Mr. H. D. Miles, signal engineer of the Michigan Central Railway, and has been used by him for some time with very good results.

It is made of four lengths of vitrified sewer pipe, the bottom and the joints being made of Portland cement unmixed with sand. A wooden box, to which the cover is attached, is carefully fitted around the top of the pipe to prevent any loss of heat by radiation during cold weather, and also to keep anyone except the proper persons from getting at the cells.

Battery cleaners should be made to examine the track wires of each circuit every time they clean the battery, so as to repair any wires that may be broken or bent out of place. When a track circuit has been installed, the sectionmen must be cautioned never to break the wires joining the rails; and if necessary to remove a rail or frog, the signal repairman must be sent for in time to get there and make the necessary connections. Trackmen have to be provided with wooden track gages, or those in which the metal end pieces are separated by a piece of wood or other non-conducting material. Hand and push cars must be provided with wheels having wooden centers, or else they will short-circuit the relay and set the signal at danger. This, perhaps, would not be advisable if it were not that the weight of these cars is not sufficient to make a good contact with the rail when they are running, especially if there is a little sand or dirt on the rail, the result being that the relay is alternately demagnetized and energized, at times with great frequency. With a mechanically-worked signal this will keep the signal turning continuously, running down the weight and subjecting the mechanism to severe strains. With the electric and pneumatically-operated signals, there is no danger of running the signal down, but the frequent operation will, with the pneumatic signal, be a useless waste of power.

and with the other may possibly cause it to get out of adjustment.

The question of finding the cause of a signal's failing or giving a wrong indication is one that will occasionally perplex the most experienced, and, what is more, is one that it is very hard to get the average repairman to study up sufficiently to be able to reason out what the cause of the trouble is and how to fix it. A detecting galvanometer will be found a very useful instrument to have in one's outfit of tools when working on electric circuits, as it will not only give approximately the amount of current, but will show the direction in which the current is flowing. If one does not have a galvanometer, an ordinary 4-ohm sounder will answer just as well for testing out and finding a break in any of the wires.

If a signal is found standing at danger improperly, the first thing to do is to examine the relays, as this will show whether the trouble is with the track or the signal circuit. If the relay is energized and the armature held up, the trouble is with the signal circuit; if the armature is down and the signal goes to safety when the armature is pressed up by hand, the trouble is with the track circuit. If the track circuit is at fault it must be tested out with the galvanometer, commencing at the battery and working towards the relay until the trouble is found. If the needle of the galvanometer deflects, as it should when the wires attached to the instrument are placed on opposite rails, the circuit is good up to that point and the trouble must be looked for further on. By disconnecting the wires from the relay and running a wire from the end of one to the rail joined by the other wire, the wires run in the trunking may be tested, as the trouble will sometimes be found to be with these wires where they have broken, or where the soldered joints have rusted out. With the relays, screws may work loose, dirt get between the contact points, or the armature may stick from polarization, any one of which may cause the signal to give a wrong indication, so that a repairman looking for the cause of trouble must carefully examine all the parts to see that everything is working properly and is just as it should be.

Where a signal stands at danger continuously, the cause of the trouble is easily located; but when the trouble is intermittent—that is, when the signal will work for a short time and then will stand at danger without apparent cause—it is much more difficult, and it is sometimes quite a problem to find out just exactly what the trouble is. In this latter connection it may be well to mention that the currents from electric street railways, if any such are near a track circuit, will almost always give trouble unless proper means are taken to make the current from the track-circuit battery flow in the same direction as the induced current, and also to insulate the track circuit as far as possible from such current.

By testing with a galvanometer or volt meter, the direction in which the current is flowing is easily determined and the current from the track battery is made to flow in the same direction, otherwise the induced current, being much the stronger of the two, is apt to reverse or neutralize the other and the relay will not be energized. If this will not overcome the difficulty, the surrounding track should be tested out with a volt meter and the point from which the current emanates, or the place showing the highest voltage, be determined. If one or two rails between this point and the track circuit be cut out as a dead section and well grounded, it will be found to prevent any current from leaking across to the track circuit.

Where such currents are known to exist, I give the wooden splice bars and the end posts, before they are put in use, a good coating of asphalt paint to make them waterproof and as good a non-conductor as possible, although I am not prepared to say that this is necessary, or that the effect is beneficial for any length of time. Certain it is that the induced currents are at times large, as at one place that I know of the current is large enough to magnetize a four-blade knife sufficiently to make it stick, as shown in Fig. 5, when placed against the vertical side of the head of the rail and across the insulated joint, the signal going to clear with the battery cut off from the circuit. On an insulated section of track, very near the one just spoken of, there is an induced current that will work a relay perfectly without any battery whatever, a battery being used merely as a precaution against a possible cessation of the induced current.

Any track having cinder ballast will be found very hard, if not impossible, to make work in all conditions of weather, as the cinder when wet becomes a good conductor, allowing the electricity to flow from one rail to the other, short-circuiting the relay and putting the signal at danger. The only way in which the difficulty may be overcome is to remove the cinder, as putting a thick layer of gravel on top of it cannot be relied upon to entirely prevent leakage.

In regard to what it will cost to install and operate the different systems of block signals, it is somewhat difficult to reduce the figures to a common basis by which to make comparisons, from the fact that where operators are employed to work the signals they are given in many cases other duties to perform, so that the entire amount paid them as wages should not be charged to the cost of operating.

For the sake of comparison, let it be assumed that the road to be signaled is 100 miles long, the blocks to be four miles long where the telegraphic and controlled-manual systems are installed, and but two miles long when the automatic is used.

The cost of the telegraphic system would then be as follows:

INSTALLATION.

Equipment complete for 25 stations, each consisting of a two-blade signal and the necessary telegraph instruments, at $65 each.	$1,625 00
Block wire line at $25 per mile...	2,500 00
Total cost...	$4,125 00

OPERATION.

Fifty operators at $40 per month each...	$2,000 00

MAINTENANCE.

Wages signal repairers and linemen, per month...	$20 00
Battery supplies and other material for repairs, per month...	30 00
Total...	$50 00

These figures are applicable to any road, whether single or double track, where the blocks are four miles long, and while this amount will have to be expended if the signals are used, all of it should not be charged against the signals when arriving at the cost of the system. Where the business is such that a road can use its station agents to block trains, there will be no additional expense incurred at these stations, and the $40 paid the agent should be deducted from the estimate. Again, operators are required at all stations where the agents cannot be made use of, at night, as well as in the day, for the purpose of dispatching trains, so that where these are employed it will also not cost any more to operate the signals.

As to the number of operators that will have to be put on in addition to those already employed, when the signals are put in service, it can be stated that with roads doing a business such that the blocks can be four miles long, it will be found, in most instances, that something like ten operators per 100 miles will be required; that number being the average increase required on several divisions of the C., M. & St. P. Ry., when the signals were put in use.

If the estimate of the cost of operating the signals was made on this basis, the amount would be but $400 a month, instead of the $2,000 previously estimated. Taking these figures, interest on the original investment at 6 per cent., and the wages of the repairman, and adding them, we get $5,827.50 as the total amount per 100 miles of road that it will cost most railroads to operate a telegraph block-signal system for the period of one year.

With the controlled-manual systems, the first cost is about $400 per station, outside of the tower, for the Sykes, and $600 for the Patenall instruments, though I cannot say that these figures are absolutely correct, having been unable to obtain any very definite information. The cost of operation of these systems is practically the same as the telegraphic, but the cost of maintenance is very much more, as will be seen by the following table, which was kindly sent me by Mr. D. B. McCoy, superintendent of the Hudson River Division of the N. Y. C. & H. R. R.R.

Cost of Operating and Maintaining (Electrically) One Tower, One Month.

Controlled-Manual Block Signals—Hudson Division, N. Y. C. & H. R. R.R.

	Patenall System.		Old Sykes System.	
	Telegraph.	Not Telegraph.	Telegraph.	Not Telegraph.
Operating	$100 00	$80 00	$100 00	$80 00
MAINTENANCE:				
Wages, batterymen, electricians, linemen, etc.	8 25	8 25	7 50	7 50
Battery supplies	2 25	2 25	1 75	1 75
Breakage, etc. (including incidentals and tower supplies)	75	75	25	25
Total	$111 25	$91 25	$109 50	$89 50

On this road the signal towers were so located that interlocking machines could be put in and the block operators made to throw switches, and perform other work besides that of blocking trains. On the Erie road the instruments are placed inside many of the stations, where the man employed to work the signals could be given other work.

The cost of the Hall automatic track-circuit system applied to a single-track road, with the blocks two miles long, is $800 per block, or $40,000 for the 100 miles. For a road having double tracks, the cost will be $60,000, the blocks also being two miles long.

For operation and maintenance, including battery supplies, etc., we have—

For single track, per month	$400 00
" double " "	500 00

As the total cost of the system for one year we have:

For single track—	
Interest on $40,000, at 6%	$2,400 00
Operation and maintenance	4,800 00
Total	$7,200 00
For double track—	
Interest on $60,000, at 6%	$3,600 00
Operation and maintenance	6,000 00
Total	$9,600 00

To equip a road with the Westinghouse pneumatic will cost about $80,000 for single track and $100,000 for double track. This allows for three power stations at a cost of $2,500 each, and a 2-inch supply pipe for carrying compressed air, the pipe being run on stakes and not buried in the ground. Operation and maintenance will be the same as with the Hall system, with the cost of running the power stations added. These figures are based on the cost of several installations that have been made by the signal company, but which are of only a few miles in length. The company, for some reason, are unwilling to furnish an estimate for publication, but the figures given will be found very nearly correct. It is possible, however, that with the reduction that has been made of late in the cost of most signal material, the figures may be reduced somewhat.

The cost of the staff system will be:

25 sets instruments, at $400	$10,000 00
Line wire, at $25 per mile	2,500 00
25 cranes for holding staffs, at $15	375 00
Total	$12,875 00

To this must be added the cost of equipping all the engines of the road, which will be at least $10 an engine.

Signals of some kind, preferably of the semaphore pattern, should be provided to indicate to an engineer whether the staff is ready for him or not. These might be of cheap construction, and need cost but $45 per station. Operation and maintenance will be about the same as with the telegraphic system

For a single-track road, the telegraphic is undoubtedly much the cheapest system that can be used; while for double track the cost of the automatic and the telegraphic systems will be about the same, it being possible to do away with a great many night operators where the former system is used. Where there are more than two tracks, or where men have to be employed solely for the purpose of blocking trains, the automatic will be much the cheaper, as the services of these men can be dispensed with, and the amount paid them for wages, to a great extent, saved.

In making these estimates, depreciation has not been taken into account, for the reason that, from the short time that most of the systems have been in use, it is impossible to say exactly what this will be. With the data available at the present time, any estimate that might be made would have too large an element of guess-work about it to make the results arrived at of any value.

Measurement of Heating Surface.

A paper was contributed to the Master Mechanics' Convention by Mr. F. W. Dean, of Boston, on the Measurement of Heating Surface, which ought to lead the way to an important reform. The prevailing practice in computing the heating surface of boiler tubes is to measure the outside area, but this practice is by no means universal. At least one locomotive builder, the Rhode Island Locomotive Works, measures the inside surface of the tube, and the same method is followed by a few master mechanics. Those who measure the heating surface in this way argue that it is the correct method, and they are no doubt right, but it makes the boilers appear to have much less heating surface than those that have the measurement of tubes computed from the outside.

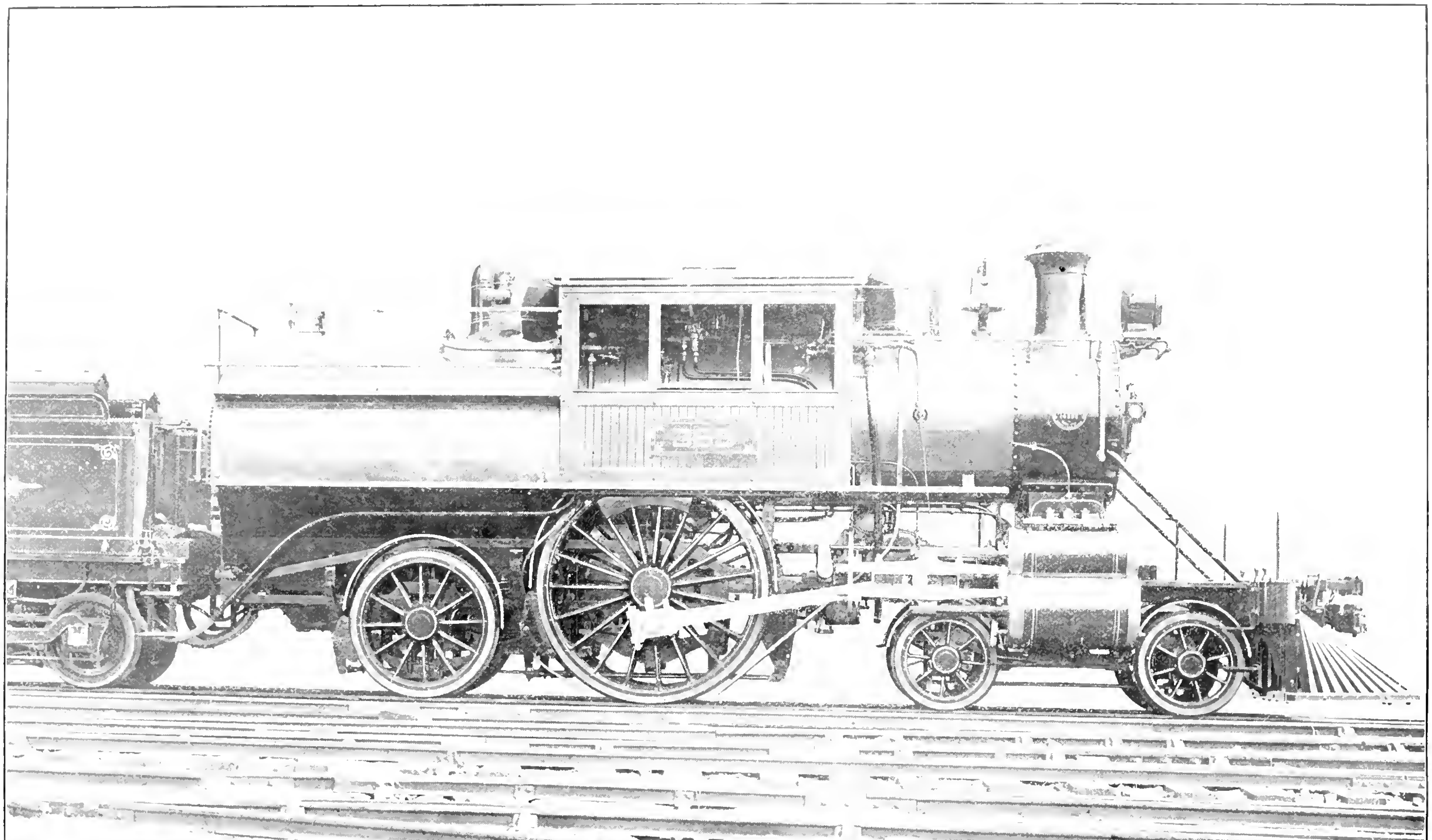
Practically, all private boiler-making establishments compute the heating surface of the tubes from the outside, for they are interested in trying to make the heating surface to appear as liberal as possible. The United States Navy have lately adopted a rule which requires the outside of a tube to be taken for the measurement of heating surface, and this practice prevails in Great Britain for locomotives, marine and stationary boilers. An anomaly about this practice is that a thick tube seems to increase the heating surface above that of a thin one; and yet the thin tube transmits the heat more readily to the water, and provides a more efficient heating surface, than the thick one. For that reason the heating surface ought to be computed from the inside of the tube; but still, it is not desirable to insist on this reform since the other practice has met with almost general adoption. The most important move is the adoption of a standard rule. The Master Mechanics' Association ought to decide upon this without delay, and it would be in the interest of all boiler users if the American Society of Mechanical Engineers did likewise.

To Prevent Unnecessary Smoke.

A committee of the Traveling Engineers' Association have sent out a circular calling for information on the question: "How can the traveling engineer assist in preventing the unnecessary emission of black smoke?" The subject is of very great importance to railroad men; for, in spite of all that has been said and done to propagate the science of good firing, there is still to be seen in all quarters a lamentable amount of unnecessary black smoke.

Twelve questions are asked in the circular, and they cover the whole subject. If we were asked to answer briefly what are the means required to prevent unnecessary emission of black smoke, we should say: Fit up locomotives with substantial air-tight ash pans, and provide dampers that could be closed tight without superhuman effort on the part of the fireman. Make the dampers so that the extent of opening could be regulated. Provide a brick arch and restricted means of admitting air above the fire. Add to this an engineer and fireman who take an interest in preventing the emission of unnecessary black smoke. All the recommendations given are important; the last is of greater importance than all the others. No combination has ever been tried for the prevention of smoke that would act well without intelligent human co-operation. A good fireman is aided by smoke-preventing devices, but a good fireman will do better with a plain firebox than a poor fireman will do with all the smoke-preventing attachments that can be secured to the firebox.

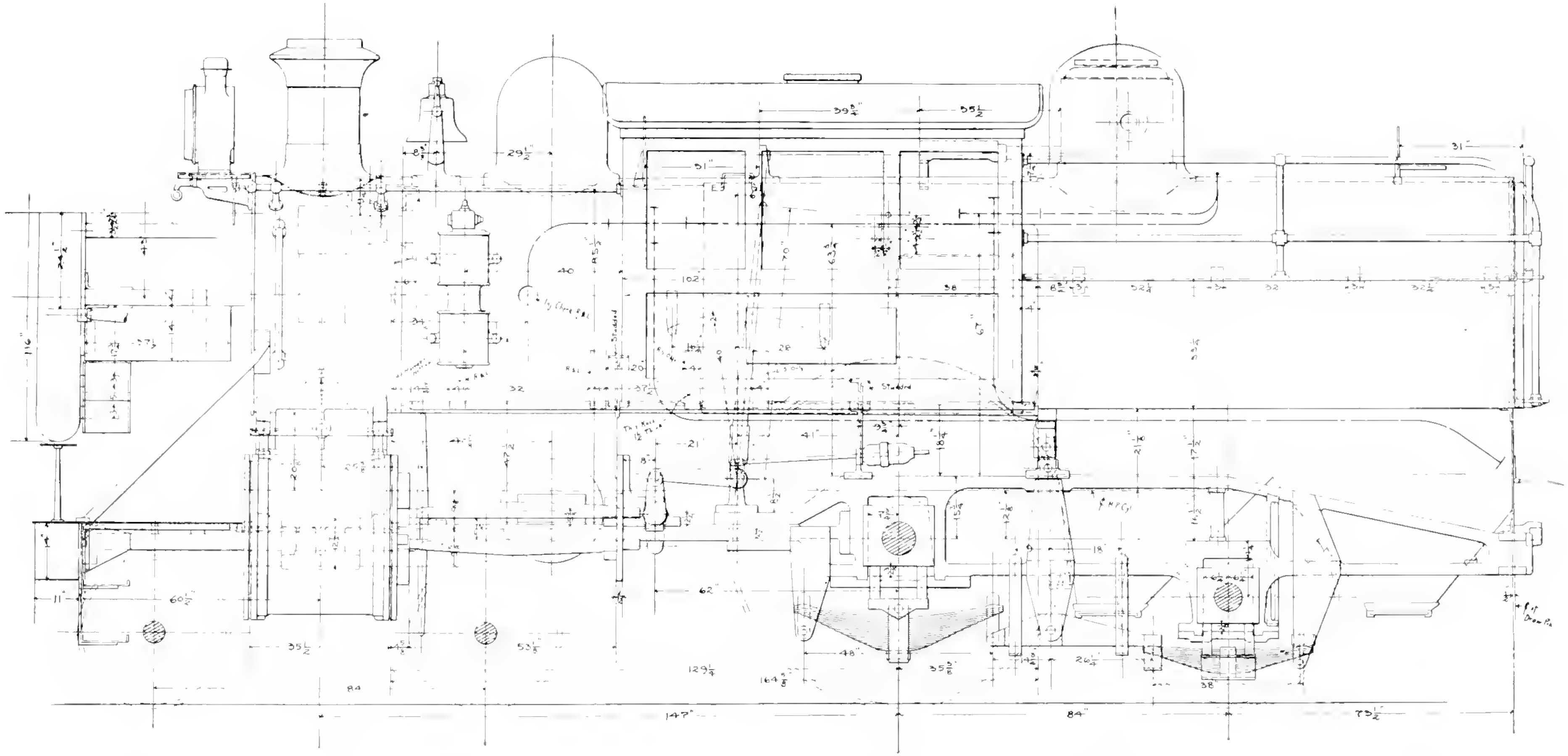
Electricity is becoming an active rival of steam in railroad operating, but it is not making half the headway that some electric cranks try to make out. Within the month, another elevated electric railway from New York to Chicago has been incorporated, with an imaginary capital of $200,000,000. Of course, the trains are going to be run at 100 miles an hour.



L. B. Paxson Supt. M. P. and R. E.

THE READING'S SINGLE-DRIVER LOCOMOTIVE

Built by Baldwin Locomotive Works



The Reading's Single-Driver Locomotive—For the Royal Blue Trains.

One of the most notable departures from the staid practice of American locomotive designers has been made by Mr. L. B. Paxson, superintendent M. P. and R. E. of the Reading road, in building a "single" engine for express service between Philadelphia and New York.

Locomotives with a single pair of drivers have long been built and used in Europe, and have there their friends and their foes.

The engine shown in our engraving is the best-designed "single" engine we have ever seen described, and is the result of a unique experiment.

Some time ago Mr. Paxson had a conversation with some of the officers of the Baldwin Locomotive Works, when the subject turned on the fast light trains on the road and the kind of engines that would do the work best.

Mr. Paxson said he could try a "single" without expense—and he did.

He took the side rods off an engine having four drivers and a single truck forward and back—otherwise like the engine in the picture—and put weights near the pins of her idle driver to offset the effect of her counterbalance, and put the engine into service.

This engine was about ready to go into the shop, but she did nearly as well as the coupled engines, and remained on the run six months, convincing everybody who was watching her that a properly designed "single" would do the work satisfactorily.

The ultimate design of the engine was placed in the hands of Mr. Wm. P. Henszey, the veteran designer of and one of the firm operating the Baldwin Works.

The results are shown in our photographic reproduction and drawings.

English "singles" have no equalizers, and, in order to give them the necessary adhesion, weight is piled upon the drivers, with the result that in running, the engine has an uncomfortable habit of see-sawing over the center. This engine's drivers are equalized with the trailing wheels by a nice system of underhung springs. This makes her, in service, something similar to an eight-wheeler, so far as the track is concerned.

Ample journal bearings make the engine run cool; the driving box and that on the trailing wheel are each 12 inches long.

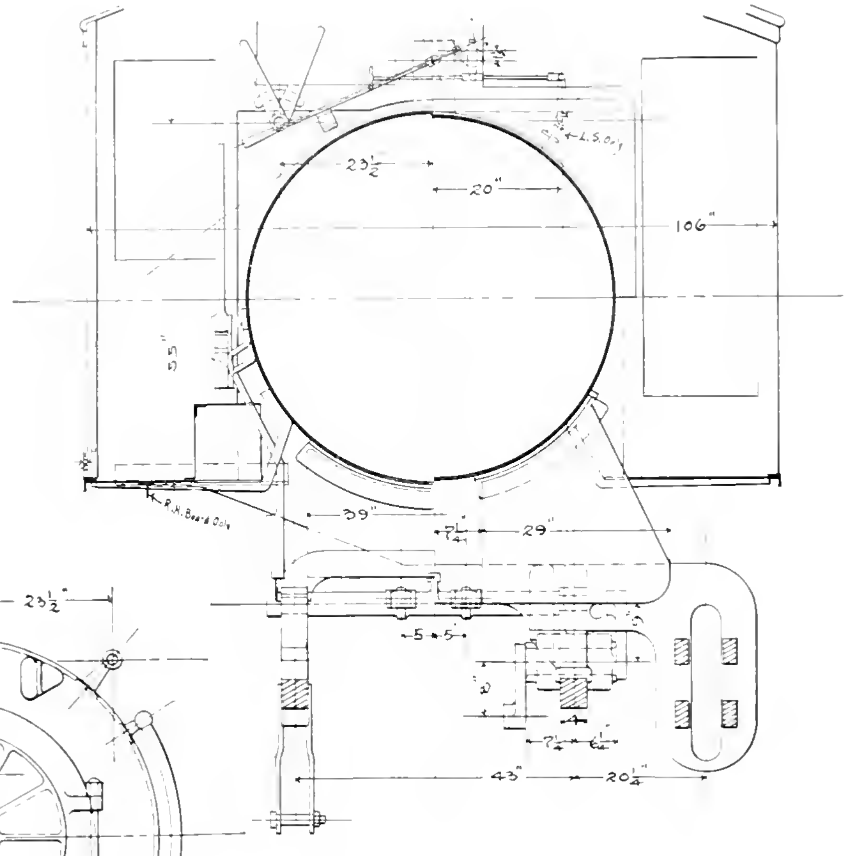
The dome is placed over the firebox and behind the cab; this is unusual, but gives room in the cab, allows the men to see, and prevents the surge of water ahead at stops from entering the dry pipe to injectors, etc. Three 4-inch pops are

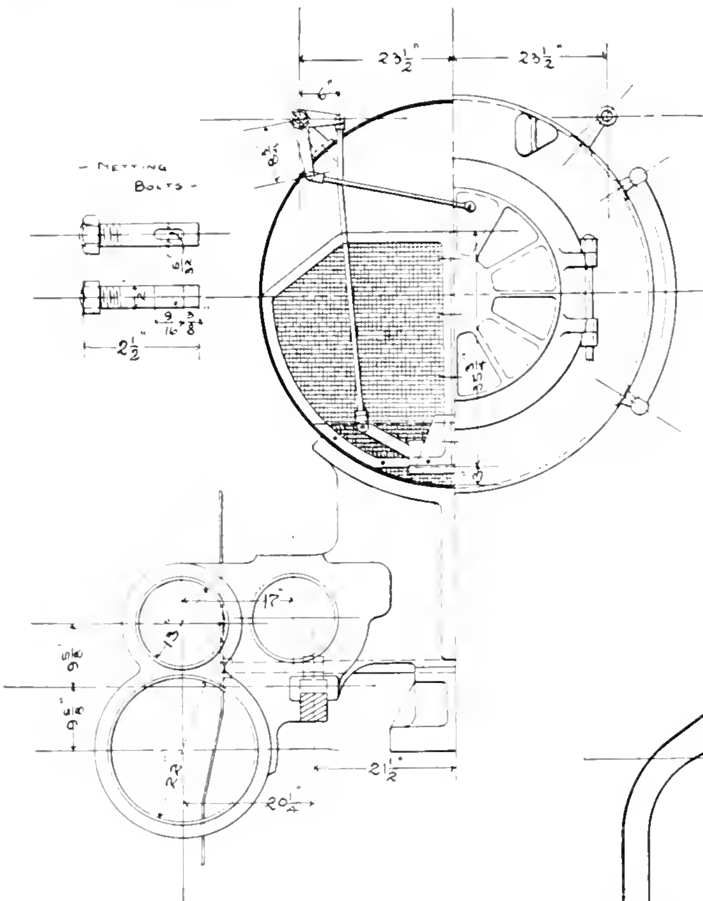
used—two on the left side of the dome and one on the right; one of these is set to pop at 195 pounds pressure, one at 198, and the third at 200; when steam is suddenly shut off, that 8½ x 9-foot fire makes all three pops sing at once.

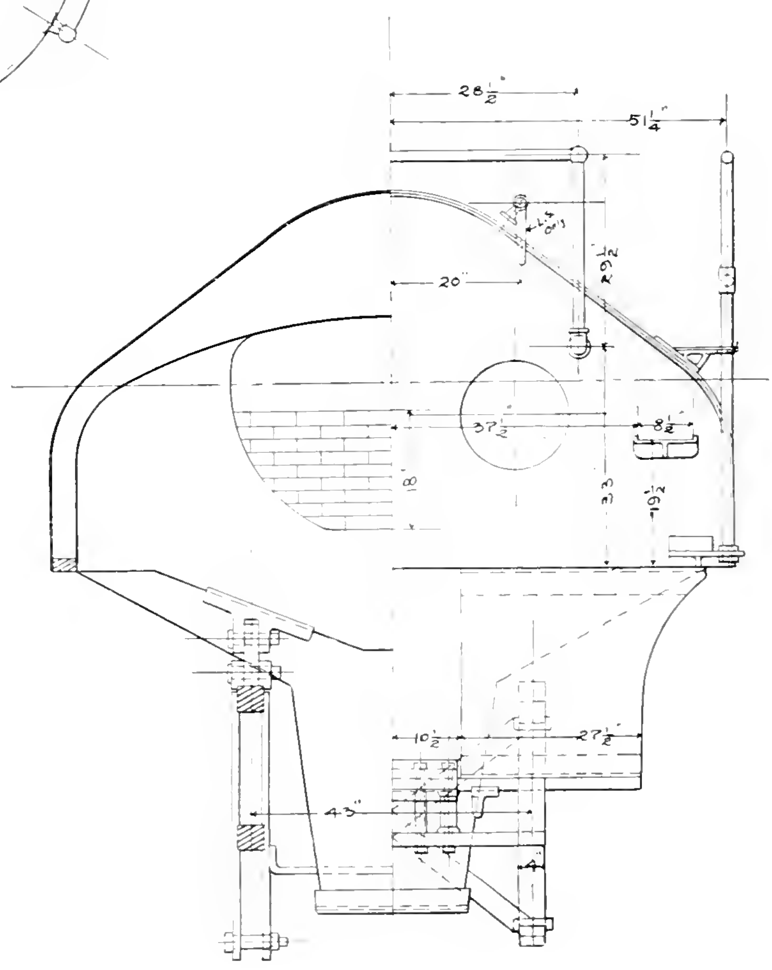
The cab is wonderfully comfortable; being in the center of the boiler, there is little vibration, and each side is roomy. The throttle is an innovation; the stem coming, as it does, from the dome in the rear of the cab, shoves in instead of pulling out, and has a long stem running in brackets on top of the boiler. The lever is the regulation Baldwin ratchet, but on the stem, between the brackets, there is a stiff-coiled spring, which is adjusted by a hand nut; the tension of this spring tends to open the throttle, and can be so adjusted that the engineer can handle his valve easily without jerking. On the stem outside of the first bracket, a coarse-pitch thread is cut, and a heavy, knurled brass nut is placed; when the engineer leaves his engine he can quickly run this nut up to the bracket and lock the throttle shut. There are sandboxes in the back of the cab to use for backing up, provided, as the regular box is, with Leach air sand jets.

The tires are secured on the drivers by retaining rings; but an improvement over the Mansell pattern is that they are lipped into the wheel center as well as the tire, the rivets merely holding the ring in place.

The engine and tender are painted Royal Blue and gold-leafed to match the trains hauled, and look very handsome.







Gould couplers and passenger platform buffers are used on the engine both forward and back.

Both injectors are on the right side; the blower can be worked from either side of the cab or from the firebox deck, and there is a steam gage and light on the rear of firebox for the benefit of the fireman.

The driver and trailing-wheel brake shoes are on the rear of the wheel, which plan gives a splendid chance to get all the brake apparatus in in nice shape; the push cylinders are located just back of the guides; the levers are straight, stand vertical, and are fulcrumed in the plate bracket shown just ahead of the driver.

There is no reach rod on engines with cab located as this one is; the tumbling-shaft arm is simply extended up to form a reverse lever.

The writer rode on this engine from Philadelphia to Jersey City when she was pulling four vestibuled cars, and was surprised at the ease with which she started the train without slipping, and with the use of very little sand. She is unqualifiedly the best riding engine I was ever on, curving with great ease and smoothness, running very fast, and keeping her 200 pounds pressure all the time with very little effort on the part of the fireman. She takes four cars East and seven West, and her builders are confident that she can make time with nine. On the trip over, we ran many miles in from forty-five to fifty seconds, and made eighteen miles in fifteen minutes with ease.

On the return trip she hauled eight cars, four of them 12-wheelers; left four minutes late, was stopped on the road seven times on account of track or signals, and arrived only nine minutes late at Philadelphia.

The engine has never been speeded; Mr. Paxson says she was built to haul the regular trains on time, and when she does that he is satisfied—she is not an experiment.

This engine came out of the Baldwin shops new on the morning of July 3d, was fired up and blown out after a little exercising. On July 4th she hauled a special train to Bound Brook and return, 120 miles, making many miles in less than 45 seconds, and the next day went into regular high-speed service, and has never missed a trip since.

She is a Vauclain compound, and when working the hardest at speed, makes less noise at the exhaust than the injectors do—they sing right lively.

She has a short smoke arch, with a vertical netting and a variable exhaust nozzle. The Wootten firebox has a brick bridge wall at the combustion chamber.

For fast trains of medium weight I am satisfied that the "single" engine is the thing, and will do her work easier and better than a four-coupled engine. It is possible to get the boiler lower and drop the firebox down, get rid of the side rods and a good deal of internal friction, and have all the adhesion that seems necessary.

The following are the general dimensions of this locomotive:

Gage of track, 4 ft. $8\frac{1}{2}$ in.
Cylinders, 13 in. H. P., 22 in. L. P., by 26-in. stroke.
Driver, $84\frac{1}{4}$ in. diameter, cast steel.
Total wheel base, 22 ft. 9 in.
Rigid wheel base, 7 ft.
Wheel base, engine and tender, 50 ft.
Weight, in working order, 115,000 lbs.
Weight on drivers, 48,000 lbs.
Weight on trailer, 28,000 lbs.
Weight on truck, 39,000 lbs.
Limit of height, 14 ft. 3 in.
Limit of width 9 ft. $3\frac{1}{2}$ in.

The tender has a water capacity of 3,500 gallons, frame of 8-in. channel iron; fitted with water scoop; Boies wrought-iron center steel-tired wheels; journals, $4\frac{1}{2}$ x 8 in.

This engine is known in the works as Class $8\frac{40}{22}\frac{1}{4}$ A.

I have before me a copy of the official train sheet of the road showing eleven round trips of this engine, which shows conclusively that she does not make her time by fast running in spurts; "On Time" at almost every stop shows good work. She makes five stops going in one direction and seven in the other.

You Don't Have to Guess What This Means.

Boiler, Wootten; shell, 56 in. diameter at arch, straight, made of $\frac{5}{8}$ in. steel; longitudinal seams butt jointed; circumferential seams, double riveted; working pressure, 200 lbs. per square inch; dome over firebox.

Three hundred and twenty-four tubes $1\frac{1}{2}$ in. diameter, 13 W. G., and 10 ft. 3 in. long.

Firebox 114 in. long by 96 in. wide; side, back and crown sheets $\frac{3}{8}$ in. flue sheet $\frac{1}{2}$ in. thick, water space $3\frac{1}{2}$ in.

Crown supported by crown bars of inverted T irons set $2\frac{1}{2}$ in. above sheet; staybolts $1\frac{1}{8}$ in. diameter, spaced 4 in. between centers.

Water tube grates and bars.

Engine truck, rigid, center bearing; 36 in. wrought-iron Vauclain wheels, steel tired; journals, $5\frac{1}{2}$x10 in.; trailing wheels, $54\frac{1}{4}$ in., cast steel; journals, 7 x 12 in.

The valves are $11\frac{1}{2}$ in. diameter, piston pattern; drivers (2) $84\frac{1}{4}$ in. diameter outside tires; centers, 78 in.; tires, $3\frac{1}{8}$ in. thick, 6 in. wide; journals, $8\frac{1}{2}$ x 12 in.; Sellers' "'87" injectors, No. $10\frac{1}{2}$; Westinghouse brake on drivers, trailer, tender and train; $9\frac{1}{2}$ in. pump, air signal, Leach sanders and U. S. metallic packing.

The boiler is lagged with magnesia blocks, and all the trim is bright iron.

The No. 385 "single" is a success and all that an express engine should be—who asks more? J. A. H.

The micrometer caliper has worked wonders in the domain of accurate measurements, but when we come to think of it, every screw possesses the capabilities of micrometric adjustment. A thousandth of an inch in diameter or a thousandth of an inch variation in the nearness of two pieces of metal to each other will, at times, mean the difference between cool running and heating and cutting. Carelessness in the use of adjustments that might be fine is nowhere better illustrated than in the abuse received by the tail stock center of a lathe. There is a personal equation entering into the adjustment of this center that cannot be "described in books"—the spring of the parts, the touch of the hand and the weight of the piece. But, as a passing thought, it may be well for the beginner to remember that, if the tail stock screw be cut with five threads to the inch, a twentieth of a turn will advance or retract the center a hundreth of an inch, and that for light work this ought to be enough to keep the work well lubricated.—*J. H. Allen, in Dixie.*

Locomotive Engineering

A Practical Journal of Railway Motive Power and Rolling Stock.

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Stationary Wedges for Driving Boxes.

One of the distinguishing features possessed by the American locomotive, which is different from those of other countries, is the movable wedge, which provides an easy and expeditious means of taking up the lost motion due to the wear of the driving-box sliding surfaces. The convenience of this arrangement is so striking that locomotives built in Europe for railways in South America, Australia and other parts of the world have had the movable wedge specified, and we understand that the mechanical departments of some European railways have adopted the use of movable wedges. With this testimony in favor of the movable wedge, it seems strange to learn that several American railroads have decided to abandon its use and are steadily equipping their locomotives with fixed wedges. To let the movable wedge go seems like parting with a cherished idol; but there is good reason for believing that those who are adopting the stationary wedge are moving in the right direction, and that the change will reduce the amount of running repairs.

At the last Master Mechanics' Convention, during the time set apart for the discussion of topical subjects, the question was raised, "Is the use of an adjustable wedge for a driving box a necessity?" We expected that the verdict would be almost unanimously in the affirmative, but instead of looking at it in that light most of the speakers were warmly in favor of stationary wedges. Mr. H. A. Childs, master mechanic of the Erie, stated that the subject of trying stationary wedges was brought up at a meeting of the master mechanics of the road. Shortly afterwards he fitted up an engine with stationary wedges, and the result was so satisfactory that they kept on making that change, and now they have twenty-four engines running without adjustable wedges. Mr. A. E. Mitchell, superintendent of motive power, intimated that there are locomotives on every division of the road running with fixed wedges, and the change has done so much to decrease the call for repairs that they are considering the advisability of adopting the practice for the whole system. A good indication that the practice is popular is the fact that the engineers running engines that have not been changed are daily making the request that their engines be fitted with fixed wedges.

In the course of the discussion that followed, the fact was brought out that the Chicago, Burlington & Northern, the Chicago, Burlington & Quincy, and the Flint & Père Marquette have been experimenting for some time with stationary wedges, in every instance with the most satisfactory result. The first two roads have adopted the practice, and are gradually removing the movable wedges from all their locomotives.

In connection with this change, the question has been raised, Where is the gain? That is the real kernel of the nut. If there is no gain, there is loss of time and labor in making the change. At present a large proportion of roundhouse repairs is connected with wedges and wedge bolts. There is no doubt but much of the repairs necessary to side-rod connections and to pedestal faces is due to the injudicious adjusting of wedges or to the want of adjustment. There has been no change effected in the moving parts of locomotives that has done so much to reduce repairs as the introduction of solid-ended side rods. The reason given for making this change was that badly keyed rods frequently caused accidents, which was certainly true. All the arguments in favor of solid-ended side rods hold good in favor of stationary driving-box wedges. In fact, the solid-ended side rod and the stationary wedge ought to go together. When there is no ready means of changing the distance between the centers of the side-rod crank pins, there ought to be no ready means provided of changing the distance between the centers of the axles.

Providing the means of jamming the driving box tight between the pedestals has a tendency to make many engineers whimsical about wedges. Every pound about the engine is attributed to lost motion in the axle boxes, and orders to set up wedges are given when the box is too tight instead of being too loose. The change from adjustable wedges to stationary ones will not be unattended by grief. The man whom a rattling side rod made nervous will go nearly crazy over driving boxes worn enough to cause real pounding. And this is where the danger point comes in. On railroads where the running repairs are well kept up, the pedestals will be lined as soon as a piece of planished iron can be put in, and the engines will work as smoothly and noiselessly as those with adjustable wedges well kept up. But on many roads during the busy season it is difficult holding in an engine for an hour if she is fit to pull a train. On these roads trouble will surely come on the introduction of stationary wedges. A speaker at the Master Mechanics' Convention said that they were prohibited from causing nuisances, and he feared that some locomotives with stationary wedges, would sound like threshing machines going along the road. There was a basis of seriousness to the joke. Those who have run locomotives with stationary wedges know that the machines soon hammer the boxes to pieces when repairs are neglected.

We believe that a railroad company will be the gainer by adopting stationary driving-box wedges if they only attend to doing the running repairs regularly. If the repairs are neglected, and driving boxes allowed to become very loose before the pedestals are lined, the change will prove expensive and annoying. At the Master Mechanics' Convention several of the speakers appeared to think that there was a likelihood of trouble being experienced with driving boxes getting stuck, with no means provided of releasing them. This we can assure all concerned is an imaginary danger. The writer was for ten years connected with the running of locomotives having no movable wedges and never heard of a box sticking in the jaws. He has, however, seen a good many axle boxes broken by pounding after they became too loose. That is the only trouble that may be anticipated if stationary wedges become the rule on our locomotives.

If a superintendent of machinery has decided to adopt the use of fixed wedges, he ought to proceed about the business systematically, with the view of reducing the cost of repairs. Doing away with the wedge bolts is a good beginning, for it is following the sound policy of reducing the number of movable parts, and will be as satisfactory as the practice of doing away with side-rod straps and bolts. But that does not cover the whole improvement. The pedestal jaws ought to be made parallel, and then there would be no more need for wedges, but pedestal shoes made in rectangular section, a form much easier fitted and easier kept in shape than a wedge. The faces of these shoes ought also to be made wider, to give a larger wearing surface. If they were made of chilled iron it would be all the better. When the guides for the axle boxes are improved in this direction, there will be little call for lining up. One or two linings between general repairs will be sufficient, and the change will greatly lighten the labors of overworked roundhouse men.

Merits of Light and Heavy Driving Wheels.

In another part of this paper, Professor Sweet, of Syracuse, N. Y., the well-known designer and builder of the Straight Line engine, draws attention to the fact that reducing the weight of driving-wheel centers has a tendency to make the action of the counterbalance harder on the track than it would be with heavier wheels. We believe that this fact has not been lost sight of by those who are doing their best to reduce the weight of driving wheels; but they believe that their labors are calculated to overcome an action which is harder on the track than the hammer blow. This is the solid hammering of heavy wheels with no spring intervening to soften the blow. With the increasing size of locomotives the driving wheels have kept up in increase of weight, until now the parts under the springs are heavier than the whole engine was in early days. With the thick tires that are now used and the mass of cast iron forming large driving-wheel centers, the wheels become a revolving hammer which is terribly destructive to rail joints. If the engineering department of our railroads was as influential as the same department of foreign railways, there would have been a movement started long ago to lighten the weight of driving wheels.

As the present movement to reduce the weight of driving-wheel centers is part of an effort to lighten all the parts that are uselessly heavy, and as the reciprocating parts are receiving particular attention, the driving-wheel will have less to do as a fly-wheel.

As the great mass of our readers have a very vague idea of the disturbing influences which a heavy driving wheel tends to keep in check, we will give a brief explanation. A wheel, to revolve smoothly, must be evenly balanced—that is, the metal must be so distributed that no particular part is heavier th n another. It is necessary to put a crank and crank pin on the driving wheels of a locomotive, which put the wheels out of balance. Unless something is done to compensate for this disturbing element, the engine will operate with a jerky to-and-fro motion, which acts as if the engine was trying to jerk itself away from the tender. This is due to the inertia and momentum of the unbalanced parts, which act to push the wheels forward when passing forward in the horizontal motion, and backwards when traveling backwards. As a remedy to this, counterbalance weights are introduced into the driving wheels. When the crank and pin are moving horizontally forward the counter weight is moving backward and the moving forces balance each other. But the weight of the piston, crosshead and other parts that move horizontally transfers their momentum to the crank pin and increases the to-and-fro jerky action. To remedy this it is usual to put sufficient counterbalance weight to counteract the disturbing effects of both the crank and pin and the reciprocating parts.

This, however, introduces another disturbing element. While the motion of reciprocating parts may be balanced by a revolving weight, the counterbalance weight has an upward and downward motion, while the motion of the reciprocating parts is only horizontal. For this reason the weight in the counterbalance used to take care of the reciprocating parts is not resisted when going down and up, except by the rail and the springs. This is the cause of the so-called hammer blow.

But heavy driving wheels are a partial remedy, since they act like a fly-wheel. The greater the speed, the less time the force has to act in any given direction; and the greater the weight, the less the distance through which it will be moved in a given time. Therefore, the heavy wheel will render the weight to be moved by the given force in the counterbalance greater in amount, and therefore reduce the downward blow.

Imperceptible Slip of Driving Wheels.

There are many reports which come from abroad about locomotive performance and concerning noted peculiarities of locomotives, which sometimes make an American engineer wonder if the engines here and abroad are subject to the same natural laws. A few years ago the engineering world abroad was stirred to the depths to account for the imperceptible slip of locomotives. The alleged discovery of the imperceptible slip of locomotive driving wheels originated with French engineers, and a paper describing experiments that seemed to support the theory was read at a meeting of the Civil Engineers' Society of Paris, which attracted world-wide attention. The assertion was made that at high speeds certain locomotives slipped as much as 20 per cent., and that the drivers of others habitually slipped going down steep grades, the slip being backwards, or rather that the driving wheels did not advance in proportion to the velocity of the train. Detailed particulars were given which were convincing to the engineers abroad, and a learned discussion arose, in which all sorts of explanations were given for the phenomenon. The idea that a locomotive, while running, slipped more or less in a manner that was not perceptible to the engineer, and could only be detected by the use of revolution counters, became a settled article of faith abroad, and is sincerely believed to this day.

Nearly all American engineers making experiments with locomotives have tried to discover traces of this imperceptible slip, but in vain. The writer has had the revolutions of probably twenty different locomotives recorded for miles on all kinds of track, on the level, up hill and down hill, and in no instance was there any discrepancy between the revolutions of the driving wheels and the distance traveled. Mr. D. L. Barnes has made exhaustive experiments in the same direction, with the same results. Still more conclusive evidence that the locomotive driving wheels do not indulge in imperceptible slip has been presented. During the last year or two Mr. W. H. Lewis, of the Chicago, Burlington & Northern, has conducted a most exhaustive series of tests to ascertain the cause of uneven wear of driving-wheel tires. All the known forces at work to produce wear of driving-wheel tires were investigated, and no indication whatever was discovered that such a thing as imperceptible slip took place. All the conclusions of the report went to show that such a thing was impossible.

Where Locomotive Tests May Be Made.

Two years ago Mr. Robert Quayle, then master mechanic of the Milwaukee, Lake Shore & Western, was appointed chairman of a Committee of the American Railway Master Mechanics' Association on Exhaust Nozzles and Steam Passages. This subject had been under investigation for several years, but the variables of ordinary locomotive operating had prevented the committees from arriving at the exact conclusions which they desired to demonstrate. When Mr. Quayle was saddled with the responsibility of carrying on the important work, he conceived the idea that a cheap stationary plant might be constructed, on which tests of locomotives could be carried on under uniform conditions. The idea was no sooner conceived than it was put into practical form, by the construction of an inexpensive plant on which shop tests of locomotives could be carried on. By the aid of this plant accurate information was obtained, which formed the basis of a report submitted to the Master Mechanics' Convention a year ago.

Since that time Mr. Quayle has been promoted to be superintendent of motive power of the Chicago & Northwestern Railway at Chicago. The change for a time interfered with his investigations, but lately he has taken them up again, and has succeeded in getting his management to grant permission to the building of what is quite an elaborate shop-testing plant, in which it is possible to investigate many other important problems besides the forms of exhaust nozzle and steam passages best adapted for the economical operation of locomotives.

The committee appointed by the Master Mechanics' Association a year ago, to raise funds for carrying on tests at Purdue University, have failed in the work assigned to them, and there is no reason to hope that the Executive Committee will be more fortunate while railroad earnings continue so unsatisfactory as they are likely to be in the next year. The Chicago & Northwestern testing plant does not compare in perfection with that at Purdue, but it is far ahead of anything that railroad me-

chanical men have previously had access to. It seems to us that many important problems connected with the economical operation of locomotives might be settled by tests on Quayle's apparatus.

The general officers of the Chicago & Northwestern Railway are noted for their liberality in promoting educational work. We know of no higher educational work connected with railroad operating than the finding out under what conditions a locomotive can be operated most economically. When the movement was first made to raise funds to defray the expenses of tests at the Purdue University Laboratory, President Hughitt, of the Chicago & Northwestern, intimated that his company would contribute $500 towards the fund. The spirit that dictated this liberality is certain to sustain Mr. Quayle in any work he may undertake to solve unsettled problems in locomotive operating.

Not Putting Safety Appliances on Cars.

There was a panic last month on nearly all railroads when it was realized that the time had come when the law required all railroad cars engaged in interstate commerce to have the drawbars at the standard height, and to have grab irons at the ends for the safety of men coupling cars. These changes cost so little that it might be supposed that nearly every railroad company would have the work done during the two years given for making the changes in, but the thing was quite the reverse. The railroad company that had the cars in condition to comply with the law was the exception. The depression in business was held out as the excuse for doing nothing, but it was really a case of bad management. Most of the work was finally done in a rush, and cost much more than it would have done had it been undertaken during the past year, when there was so little work in the repair yards and material was abnormally cheap.

There is a much more expensive change to be made within two years and a half. On January 1, 1898, no train can be run without having a sufficient number of cars equipped with air brakes to enable the train to be controlled by the engineer, and all cars engaged in interstate commerce must be equipped with automatic couplers. Very severe penalties are provided for the violation of this law. Most of the railroad companies are doing something to be ready for this requirement, but not a few are doing nothing whatever. They depend on Congress extending the time, but they may be disappointed.

One of the most important events for railroad interests that has happened for years was a meeting of railroad presidents, called by Mr. J. P. Morgan, head of the Drexel-Morgan banking house in New York. The purpose of the meeting was to make an effort to induce railroad companies to maintain freight rates so that some profit might be realized. The Drexel-Morgan people are trustees for an enormous amount of railroad property, and this gives their representative great influence with railroad presidents. The effort to strengthen the railroad men on the rate question appears to have been entirely successful, and the indications are that railroad companies will, in future, obtain a living margin of profit for the freight hauled.

We lately heard the particulars of a case which gives a good illustration of the aggravating effect of hard times. There were five engines doing the principal passenger business of a certain road. When the hard times came on, three of the engines were badly in need of general repairs, but the order went forth to reduce the hours of shopmen 50 per cent., and the worn-out engines had to remain in service. They failed frequently, causing annoying delays, and they always did their work badly. But what was worse than anything else, the boilers were full of mud, and the quadrant notches near the center were so badly worn that the engines had to be worked with the steam following the pistons twice the distance that was necessary. The cost of this was about six dollars a trip more than would have been incurred with an engine in good condition. This is one of the many cases where reduction of expenses was a costly proceeding.

There are certain lessons of locomotive and car designing that have impressed themselves so very strongly upon the ordinary designer that he does not dare to ignore them; but every now and again a man of commanding personality stands up, prepared to be his own law and to defy the misfortunes that have come to other men who tried to make out that two and two made less than four. In locomotive designing it has been found that much more than 20,000 pounds cannot be put upon one journal without troublesome consequences. In the car department it is found wise not to exceed 250 pounds per square inch of journal-bearing surface. Several attempts have been made lately to carry more weight on the journals than the figure given. In all cases it has been demonstrated that the men responsible would have done well to be guided by the experience of those who made mistakes before them.

The mechanical department of the Union Pacific is noted for accurate records kept of everything relating to the operating of machinery. Mr. J. H. McConnell is a great believer in showing by figures the wear and durability of different material. He is at present collecting records about boiler plate, which will be highly valuable in a few years. Every sheet of steel received is tested by a skillful chemist and the chemical analysis put on record. Physical tests are also made and all particulars noted. The record of every sheet is kept in the office, and the number of the engine to which it was applied. There is an accurate history kept of it, which, after a time, will give very plain indications of the character of steel best adapted for the severe service that comes from the combination of bad coal and worse water.

The letters which come to this office indicate that the ambition to obtain patents is a sort of craze. Some men appear to think that if they design any small improvement that will make a tool or machine more convenient, they are entitled to a patent on it. That is really true; but the first consideration for an inventor, especially a poor man, is, Will it pay to get this thing patented? It generally will not pay. About one patent in a hundred brings returns for the money spent in securing the patent. Before he expends about one hundred dollars on a patent, a workman ought to consider very earnestly the chances there are of his getting the money back.

"The question of economy in shop practice is of vital importance," said a speaker at the Master Mechanics' Convention, "and in these days of enforced retrenchment we must meet the requirements of such practice. How many of us would look slightingly on the dispensing with even one laborer at the rate of $1.25 per day, in considering the retrenchment necessary in our department? Yet the pay of that one laborer is equal to the interest on $8,000 at 5 per cent. per annum. The saving due to dispensing with laborers, if applied to the purchase of overhead cranes, air-hoists and other labor-saving devices, will make a good return on the money invested."

The railway master mechanics of the country who are interested in demonstrating the value of reputed improvements, would do well to put in practice a suggestion made by Mr. A. E. Mitchell, at the last Master Mechanics' Convention, concerning wedges for locomotive pedestals. There will be a report made on that subject next year. That they might be able to answer the circulars of inquiry intelligently, Mr. Mitchell advised that they all go home and fit up an engine with stationary wedges; then they would soon have personal experience with the change which would enable each and every one to speak with authority.

We have on our suspended hook a great many letters giving particulars about notable oil and coal performances made on a variety of roads. The writers have been very kind in sending us the information, but it is not of a character that the mass of our readers are interested in, and therefore we must needs decline to publish it.

PERSONAL.

Mr. James Smith has been appointed master mechanic of the Gulf, Beaumont & Kansas City; office, Beaumont, Tex.

Mr. E. S. Brooks has been appointed assistant superintendent of the coal department of the Union Pacific, to succeed Mr. D. O. Clark, promoted.

Mr. R. R. Hammond has been appointed division superintendent of the Kansas City, Fort Scott & Memphis and Current River railroads, with headquarters at Springfield, Mo.

Mr. William Bradley, a locomotive engineer on the Baltimore & Ohio, has been appointed road foreman of engines of the Pittsburgh division of that road, to succeed Mr. James Emery, resigned.

Mr. W. T. Rupert, who has been acting master mechanic of the Chicago & West Michigan and Detroit, Lansing & Northern for the last ten months, has had the permanent appointment confirmed.

Mr. J. H. Emmert, division superintendent of the Kansas City, Fort Scott & Memphis at Springfield, Mo., formerly assistant to the general manager, has been promoted to be general superintendent.

Mr. T. H. Fitzpatrick has been appointed superintendent of the Cheyenne & Northern branch of the Denver & Gulf system, with headquarters at Cheyenne, Wyo., to succeed J. A. Rasbach, resigned.

Another railroad man has turned editor. Mr. George De Haven, general passenger agent of the Chicago & West Michigan, twenty years in the business, has gone to be managing editor of the Chicago *Mail*.

Mr. William Thornburg, who was appointed general manager of the Columbus, Sandusky & Hocking Valley by Receiver Stewart, has been retained in the same position by the new receiver, Mr. Nicholas Monsarrat.

Mr. Joseph W. Preston, formerly general manager and treasurer of the Millen & Southern, has been appointed general manager of the Middle Georgia & Atlantic, with headquarters at Atlanta, Ga., taking effect July 1st.

Mr. J. M. Carr has been appointed general foreman of motive power and car department of the Monterey & Mexican Gulf, with headquarters at Monterey, Mex. His duties are those formerly performed by the master mechanic.

Mr. D. T. Forbes has been appointed general superintendent of the New York, Texas & Mexican and the Gulf, Western Texas & Pacific roads, part of the Southern Pacific system, *vice* W. S. Hoskins, resigned. Headquarters, Victoria, Tex.

Mr. D. O. Clark, assistant superintendent of the coal department of the Union Pacific at Rock Springs, Wyo., has been appointed superintendent of the coal department, with headquarters at Omaha, Neb., to succeed Mr. G. W. Megeath, resigned.

Mr. A. M. Kinsman has resigned as assistant engineer and superintendent of construction of the Illinois Central, to accept the position of chief engineer of the Wisconsin & Michigan and Merrill Antigo & Eastern, with headquarters at Menominee, Mich.

Mr. T. A. Miller has been appointed assistant superintendent of the Aurora division of the Kansas City, Fort Scott & Memphis road, with headquarters at Aurora, Mo. The Aurora division consists of the Greenfield & Northern Railroad, which has been acquired by the K. C., Ft. S. & M.

Mr. C. L. Rossiter, for several years past assistant superintendent of the New York Central at Buffalo, has been made president of the Brooklyn Heights Street Railway. Before leaving Buffalo he was presented with a handsome diamond ring by the employés who were formerly under him.

Mr. William B. Thomas, who has been receiver and general manager of the Atlanta & Florida, has been appointed superintendent of the road, which has just been acquired by the Southern Railway. He will have charge of the transportation and roadway departments, with headquarters at Atlanta, Ga.

Mr. Charles E. Billin has been appointed the Chicago representative of Bement, Miles & Co., the well-known tool makers of Philadelphia. The opening of an office in Chicago is a new departure with this company. It will be No. 1534 Marquette Building, where Mr. Billin will be pleased to see railroad men.

One of our contemporaries published a notice last month saying that Mr. W. T. Reed, superintendent of motive power and machinery of the Seaboard Air Line, had resigned. There was no foundation whatever for the statement. Mr. Reed finds his position agreeable, although there is plenty of hard work to be done, which just suits his temperament and tastes.

Mr. M. T. Seymour has been appointed master of transportation of the Pittsburgh, Akron & Western, with headquarters at Akron, O. He was formerly superintendent of the Toledo division of the Columbus, Hocking Valley & Toledo, later superintendent of the Bluff Line at Springfield, Ill., and more recently master of transportation of the Columbus, Sandusky & Hocking.

Several important changes have lately taken place on the office staff of the *American Machinist*. Mr. Horace B. Miller, who has been president of the company ever since it was formed, and who was one of the originators of the paper, has retired, and Mr. Fred. J. Miller, chief editor, has been elected president. Mr. Charles W. Biglow is treasurer and Mr. C. A. Hausmann secretary.

Mr. Chas. Houston, one of the best-known locomotive engineers in the East, and now running a fast train on the C. R.R. of N. J., has been appointed one of the State Commissioners of Mediation and Arbitration. Mr. Houston was not a candidate for the office, and his appointment was a surprise to him. It's a neat little job for three years, and he does not have to give up his regular work unless there is labor trouble somewhere in the State.

"Enginemen's Pocket Companion" is the title of a small hand book recently published by Mr. C. W. Booth, chief clerk of the mechanical department of the Wisconsin Central at Waukesha, Wis. The book contains a great deal of valuable information for enginemen, arranged in very compact and comprehensible shape. The principal part is intended as a memorandum book in which enginemen can conveniently keep their mileage and time. To this are added instructions concerning the care and handling of brakes and signals, a chapter on combustion and one on valve motion, with other facts about temperature, steam, weights and measures, and particulars about a great variety of other subjects which it is good for enginemen to know. The book is for sale by the author.

At the shops of the W. N. Y. & P. road at Buffalo, Supt. of M. P. Allen Vail uses gages on all his air lifts about the shops. He says they are a great help to the men in showing just what they can do with a given pressure of air. On the wheel press he uses a recording gage that shows the pressure employed in putting on every wheel—if a wheel is bored too big or an axle turned too small, they can't stick the wheel on and get rid of it. If too little pressure is used in a single instance the boss knows it. The result is that the pressman won't let a wheel go out that has not required the proper pressure to send it home.

Our railroads are nearly done, for this season of depression, with the scrap heap as a source of supply, and the using of parts drawn from that fountain head has been, on the whole, an expensive proceeding. An incident mentioned in one of the Master Mechanics' reports concerning the utilization of scrap, has been paralleled in many cases, if the truth only were known. One paragraph reads: "Old tires are sometimes converted into rod straps for engines, filling pieces for frog points, and blacksmiths' tools. Your committee has no figures upon the economy of working up old tires, with the exception of the experience of one member who found that the cost of some hand hammers made of old Krupp tire was $8.98 per dozen, as against $4.50 per dozen for new hammers. He discontinued the operation."

EQUIPMENT NOTES.

The Reading are in the market for cars.

Brooks are building five engines for the Mexican Central.

Baldwins have just shipped six engines for the Ann Arbor.

The M., K. & T. order for seventeen engines went to Baldwins.

Brooks will build the Great Northern engines, seventeen in all.

The Cleveland, Lorain & Wheeling are in the market for 1,000 cars.

The N. P. are building 100 box cars at their Edison, Wash., shops.

The B., C. R. & N. have ordered 100 cars of the Wells-French Co.

The C., R. I. & P. have ordered fifteen engines of the Brooks Works.

The Missouri Pacific are having ten eight-wheelers built at Baldwins.

The Pittsburgh, Lake Erie & Western are in the market for four engines.

The Burlington, Cedar Rapids & Northern have ordered ten engines of Brooks.

The Fall Brook have ordered 500 coal cars of the Union Car Works, Depew, N. Y.

The order for eighteen broad-gage locomotives for Chile has not yet been placed.

Baldwins are building four compounds for Chile, two ten-wheelers and two eight-wheelers.

The Wheeling & Lake Erie are building 150 gondolas at their own shops at Ironville, O.

The Great Northern have ordered 750 freight cars from Haskell & Barker, Michigan City, Ind.

The Pittsburgh Locomotive Works are building nine engines for the Houston & Texas Central.

The Buffalo & Susquehanna have received the last of an order of five consolidations from Baldwins.

The contract for engines for the Tehuantepec Railroad in Mexico has been awarded to the Baldwin Works.

The Lake Shore have ordered 1,000 freight cars, divided between the Wells-French Co. and the Peninsular Car Works.

The Missouri Pacific order of 2,000 freight cars was divided between the Madison Car Co. and the Missouri Car & Foundry Co.

The Lake Shore have given an order for thirty ten-wheelers, equally divided between the Brooks, Schenectady and Pittsburgh Works.

The Madison Car Co., Madison, Ill., are building fifty-two flats for the Q. & C. They have shipped 100 box cars to the U. P., D. & G.

Those who ought to know, state that the P. R.R. have ordered seventy-five freight engines built at the Juniata shops. Part of them will be compounds.

The Pennsylvania have ordered 200 freight cars of the St. Charles Works, and 300 of the Ohio Falls Car Works. They are also building 230 at Altoona.

The West India Improvement Company have ordered from the Jackson & Sharp Co., Wilmington, Del., two passenger cars for the Jamaica Railway, West Indies.

The Beech Creek road have ordered 1,000 hopper-bottom gondolas—250 went to Murray, Dougal & Co., 250 to the Buffalo Car Works, and 500 to the Union Car Works.

The Rogers Locomotive Company have almost completed four two-cylinder compounds for the Chilian State Railways. Two of these engines are eight-wheelers and two ten-wheelers, and both classes will be used in fast passenger service. They have wrought-iron wheel centers throughout, extended wagon-top boilers with copper fireboxes and brass flues, steel cabs and six-wheeled tenders of the European type.

The works are also busy with four heavy two-cylinder compound ten-wheelers for the Jamaica Railway, similar to one built a couple of years ago and illustrated by us at the time, which has given highly satisfactory results hauling freight up long, steep grades. These engines will be fitted with the Le Chatelier water brake, in addition to the Westinghouse-American equipment, to help out while coasting down the mountain slopes.

Amongst the other engines under construction are ten 20 x 20-in. consolidations and five 19½ x 26-in. ten-wheelers for the Louisville & Nashville; a 20 x 24-in. passenger ten-wheeler for the Plant System; two 18 x 26-in. eight-wheelers for the Florida Central & Peninsular; an 18 x 24-in. ten-wheeler for the Western Ry. of Alabama, and a 19 x 24-in. switcher for the Mobile & Ohio. One of the L. & N. ten-wheelers, the Plant engine and one of the Florida Central eight-wheelers will be exhibited at the Atlanta Exposition, which opens about the middle of September.

Baldwins have just completed a complicated-looking locomotive for the railroad in San Domingo. The engine is a meter-gage, six-driver, saddle-tank affair; the two back pair of wheels are driven by four cylinders—a Vauclain compound—the forward wheels have between them gearing for an Abt system rack rail, and this rack gear and pair of wheels are driven by a pair of simple cylinders placed above the compound cylinders; the main rod from the simple engine is connected to a pair of rockers, from the other ends of which rods extend to the forward drivers. The company are building a road around the mountain on which this climber runs; when that is completed, the rack gear and simple engine will be taken off and the side rod extended, leaving the engine a plain six-wheel coupled compound. When running, the machine reminds one of a knitting machine. She weighs 62,000 pounds.

Comparative Performance of Driving-Wheel Tires.

We have received from Mr. J. H. McConnell, superintendent of motive power of the Union Pacific Railway, the following statement, showing the comparative wear of different kinds of steel tires, extending over a period of twenty years. It will be seen that the gradual increase of weight, increase of steam pressure and increase of speed steadily increased the wear per unit of miles run:

Engine 73, 8-Wheel.—Cylinder, 16 x 24; driving wheel centers, 61¾ in.; weight of engine, two gages of water, 69,500 lbs.; on drivers, 42,800 lbs.; total weight of engine and tender, with fuel and water, 121,473 lbs.; average speed at 22 miles per hour; steam at 140 lbs.; tires, Butcher steel; thickness, 2 11/16 in.; thickness at last turning, 1 14/16 in.; applied May 7, 1875; removed August 11, 1881; length of service about six years; turned off 13/16 in.; mileage, 198,865; miles to 1/16, 15,297; total mileage of tire, 245,220.

Engine 74, 8-Wheel. — Dimensions, weight, speed and steam same as engine 73. Tires, Nashua Iron Company steel; thickness, 2 11/16 in.; thickness at last turning, 1 8/16 in.; applied March 10, 1876; removed August 7, 1883; service, about six years; turned off, 19/16 in.; mileage, 284,146; miles to 1/16 in., 14,955; total mileage of tire, 314,941.

Engine 75, 8-Wheel.—Dimensions, etc., same as engine 73. Tires, Nashua Iron Company steel; thickness, 2 11/16 in.; thickness at last turning, 1 11/16 in.; applied November 7, 1878; removed April 8, 1884; service, about six years; turned off, 16/16 in.; mileage, 197,700; miles to 1/16 in., 12,356; total mileage of tire, 240,904.

Engine 76, 8-Wheel.—Dimensions, etc., same as engine 73. Tires, Krupp steel; thickness, 2 11/16 in.; thickness at last turning, 1 11/16 in.; applied February 26, 1874; removed May 20, 1881; service, about seven years; turned off, 16/16 in.; mileage, 213,456; miles to 1/16 in., 13,341; total mileage of tire, 265,796.

Engine 77, 8-Wheel.—Dimensions, etc., same as engine 73. Tires, Butcher steel; thickness, 2 11/16 in.; thickness at last turning, 1 13/16 in.; applied July 24, 1893; removed October 20, 1881; service, about eight years; turned off, 14/16 in.; mileage, 254,110; miles to 1/16 in., 18,151; total mileage of tire, 314,480.

Engines 73, 74, 75, 76 and 77, Rebuilt: Engine 73, 8-Wheel, rebuilt.—Cylinders, 17x24; larger boiler, drivers same size; weight of engine, two gages of water, 76,100 lbs.; on drivers, 47,000 lbs.; total weight of engine and tender with fuel and water, 141,333 lbs.; average speed 25 miles per hour; steam at 150 lbs. Tires, Midvale steel; thickness, 2 12/16; thickness at last turning, 1⅜; applied August 11, 1881; removed January 19, 1887; service about 6 years; turned off, 22/16; mileage, 233,266; miles to 1/16 in., 10,603; total mileage of tire, 272,319.

Engine 74, 8-Wheel, Rebuilt.—Dimensions, etc., same as engine 73 rebuilt. Tires, Midvale steel; thickness, $2\frac{13}{16}$ in.; thickness at last turning, $1\frac{13}{16}$ in.; applied August 7, 1882; removed June 1, 1890; service, about eight years; turned off, $\frac{13}{16}$ in.; mileage, 178,517; miles to $\frac{1}{16}$ in., 9,395; total mileage of tire, 286,343.

Engine 75, 8-Wheel, Rebuilt.—Dimensions, etc., same as engine 73 rebuilt. Tires, Union steel; thickness, $2\frac{13}{16}$ in.; thickness at last turning, $1\frac{5}{16}$ in.; applied April 8, 1884; removed January 17, 1890; service, about six years; turned off, $\frac{21}{16}$ in.; mileage, 192,120; miles to $\frac{1}{16}$ in., 9,149; total mileage of tire, 212,053.

Engine 76, 8-Wheel, Rebuilt.—Dimensions, etc., same as engine 73 rebuilt. Tires, Krupp steel; thickness, $2\frac{13}{16}$ in.; thickness at last turning, $1\frac{5}{8}$ in.; applied May 20, 1881; removed October 17, 1888; service, about seven years; turned off, $\frac{18}{16}$ in.; mileage, 253,416; miles to $\frac{1}{16}$ in. turned off, 14,078; total mileage of tire, 337,993.

Engine 77, 8-Wheel, Rebuilt.—Dimensions, etc., same as engine 73 rebuilt. Tires, Midvale steel; thickness, $2\frac{14}{16}$ in.; thickness at last turning, $1\frac{7}{16}$ in.; applied October 20, 1881; removed March 3, 1890; service, about eight years; turned off, $\frac{23}{16}$ in.; mileage, 285,185; miles to $\frac{1}{16}$ in. turned off, 12,399; total mileage of tire, 329,010.

Engine 823, 8-Wheel.—Cylinders, 18x24 in.; driving-wheel centers, 62 in.; weight of engine, 2 gages of water, 93,500 lbs.; on drivers, 59,600 lbs.; total weight of engine and tender, with fuel and water, 155,230 lbs.; average speed at 33 miles per hour; steam at 160 lbs. Tires, Krupp steel; thickness, $3\frac{3}{4}$ in.; thickness at last turning, $2\frac{3}{4}$ in.; applied August 22, 1888; not worn out March 12, 1894; turned off, $\frac{16}{16}$ in.; mileage, 163,448; miles to $\frac{1}{16}$ in. turned off, 10,216.

Engine 824, 8-Wheel.—Cylinders, 18x24 in.; driving-wheel centers, 62 in.; weight of engine, 2 gages of water, 101,330 lbs.; on drivers, 62,300 lbs.; total weight of engine and tender, with fuel and water, 208,563 lbs.; average speed at 33 miles per hour; steam, 160 lbs. Tires, Krupp steel; thickness, $3\frac{7}{16}$ in.; thickness at last turning, $2\frac{5}{16}$ in.; applied April 18, 1890; not worn out, November 14, 1893; turned off, $\frac{18}{16}$ in.; mileage, 174,121; miles to $\frac{1}{16}$ in. turned off, 9,673.

Engine 825, 8-Wheel.—Dimensions, etc., same as engine 823. Tires, Krupp steel; thickness, $3\frac{7}{16}$ in.; thickness at last turning, $2\frac{5}{8}$ in.; applied June 30, 1891; not worn out January 31, 1894; turned off, $\frac{13}{16}$ in.; mileage, 123,978; miles to $\frac{1}{16}$ in. turned off, 9,537.

Engine 826, 8-Wheel.—Cylinders, 18x24 in.; driving-wheel centers, 62 in.; weight of engine, 2 gages of water, 97,600 lbs.; on drivers, 63,000 lbs.; total weight of engine and tender, with fuel and water, 204,833 lbs.; average speed at 33 miles per hour; steam at 160 lbs. Tires, Standard steel; thickness, $3\frac{14}{16}$ in.; thickness at last turning, $2\frac{3}{8}$ in.; applied July 21, 1887; not worn out April 15, 1893; turned off, $\frac{24}{16}$ in.; mileage, 274,353; miles to $\frac{1}{16}$ in. turned off, 11,431.

Engine 827, 8-Wheel.—Cylinders, 18x26 in.; driving-wheel centers, 62 in.; weight of engine, 2 gages of water, 100,000 lbs.; on drivers, 64,000 lbs.; total weight of engine and tender, with fuel and water, 207,233 lbs.; average speed at 33 miles per hour; steam at 160 lbs. Tires, Standard steel; thickness, $3\frac{13}{16}$ in.; thickness at last turning, $2\frac{7}{16}$ in.; applied October 14, 1887; not worn out July 13, 1893; turned off, $\frac{29}{16}$ in.; mileage, 296,138; miles to $\frac{1}{16}$ in. turned off, 10,212.

Engine 836, 8-Wheel.—Cylinders, 18 x 26 in.; driving-wheel centers, 62 in.; weight of engine, 2 gages of water, 109,200 lbs.; on drivers, 73,400 lbs.; total weight of engine and tender, with fuel and water, 216,433 lbs.; average speed at 33 miles per hour; steam at 180 lbs. Tires, Midvale steel; thickness, $3\frac{7}{16}$ in.; thickness at last turning, 3 in.; applied May 24, 1892; not worn out February 9, 1894; turned off, $\frac{7}{16}$ in.; mileage, 92,000; miles to $\frac{1}{16}$ turned off, 13,143.

Engine 837, 8-Wheel.—Dimensions, etc., same as engine 836. Tires, Midvale steel; thickness, $3\frac{6}{16}$; thickness at last turning, $2\frac{11}{16}$; applied June 20, 1892; not worn out December 22, 1893; turned off, $\frac{11}{16}$; mileage, 76,020; miles to $\frac{1}{16}$ turned off, 6,911.

Engine 838, 8-Wheel.—Dimensions, etc., same as engine 836. Tires, Midvale Steel; thickness, $3\frac{5}{16}$; thickness at last turning, $2\frac{3}{4}$; applied May 20, 1892; not worn out April 16, 1894; turned off, $\frac{9}{16}$; mileage, 80,419; miles to $\frac{1}{16}$ in. turned off, 8,935.

Engine 839, 8-Wheel.—Dimensions, etc., same as engine 836. Tires, Midvale steel; thickness, $3\frac{7}{16}$; thickness at last turning, $3\frac{1}{16}$; applied October 11, 1892; not worn out December 12, 1893; turned off, $\frac{6}{16}$; mileage, 51,570; miles to $\frac{1}{16}$ in. turned off, 8,595.

Engine 840, 8-Wheel.—Dimensions, etc., same as engine 836. Tires, Midvale steel; thickness, $3\frac{8}{16}$; thickness at last turning, 3 in.; applied August 23, 1892; not worn out December 7, 1893; turned off, $\frac{8}{16}$ in.; mileage, 66,468; miles to $\frac{1}{16}$ in. turned off, 8,309.

Engine 844, 8-Wheel.—Dimensions, etc., same as engine 836, except weights; weight of engine, 2 gages of water, 107,000 lbs.; on drivers, 69,300 lbs.; total weight of engine and tender, with fuel and water, 214,233 lbs.; average speed at 41 miles per hour; steam at 180 lbs. Tires, Midvale steel; thickness, $3\frac{8}{16}$ in.; thickness at last turning, $3\frac{3}{16}$ in.; applied May 5, 1893; not worn out January 30, 1894; turned off, $\frac{5}{16}$ in.; mileage, 31,788; miles to $\frac{1}{16}$ in. turned off, 6,358.

Engine 845, 8-Wheel.—Dimensions etc., same as engine 844. Tires, Midvale steel; thickness, $3\frac{8}{16}$ in.; thickness at last turning, $3\frac{4}{16}$ in.; applied July 7, 1893; not worn out February 28, 1894; turned off, $\frac{4}{16}$ in.; mileage, 28,669; miles to $\frac{1}{16}$ in. turned off, 7,167.

SUMMARY.

Engine 73, etc., 16x24 in. Cylinders.—Engines 73 to 77, cylinders 16x24 in.; weight, 69,500 lbs.; speed at 22 miles per hour; steam at 140 lbs.; average miles to $\frac{1}{16}$ wear of tire, 14,722; tires, Butcher, Nashua and Krupp steel.

Engine 73, etc., 17x24 in. Cylinders.—Engines 73 to 77, cylinders 17x24 in.; weight, 76,100 lbs.; speed at 25 miles per hour; steam at 150 lbs.; average miles to $\frac{1}{16}$ wear of tire, 11,092; tires, Midvale, Union and Krupp steel.

Engine 823, etc., 18x24 in. Cylinders.—Engines 823 to 827, cylinders 18x24 in.; weight, 101,330 lbs.; on drivers, 73,000 lbs.; speed at 33 miles per hour and steam at 160 lbs.; average miles to $\frac{1}{16}$ wear of tire, 10,320; tires, Krupp and Standard steel.

Engine 836, etc., 18x26 in. Cylinders.—Engines 836 to 840, cylinders 18x26 in.; weight, 109,200 lbs.; speed at 33 miles per hour and steam at 180 lbs.; average miles to $\frac{1}{16}$ wear of tire, 8,938; tires, Midvale steel.

Engine 826, Cylinder 18x24 in., and Engine 827, Cylinder 18x26 in.—Engines 826 and 827, cylinders 18x24 in. and 18x26 in.; weight, 97,600 and 100,000 lbs.; 63,000 lbs. on drivers; speed at 41 miles per hour; fast mail; steam at 180 lbs.; average miles to $\frac{1}{16}$ in. wear of tire, 8,914; tires, Standard steel.

Engines 844 and 845, Cylinders 18x26 in.—Engines 844 and 845, cylinders 18x26 in.; weight, 107,000 lbs.; 69,000 lbs. on drivers; speed at 41 miles per hour; fast mail; steam at 180 lbs.; average miles to $\frac{1}{16}$ wear of tire, 6,717; tires, Midvale.

We should advise the people who are in the habit of applying new tires to the wheel without turning them, to be careful that those on the different wheels approximate the same diameter. Mr. David Brown, the master mechanic of the Delaware, Lackawanna & Western, at Scranton, Pa., incidentally said: "We had an annoying experience with tires applied by the builder of a Mogul engine without turning. The builders had received the tires from the makers in sets that were of uniform size, but in putting on the tires the sets got mixed, and we found tires on the same axle differing from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. The first notice we had of something being wrong was the cutting of flanges."

An interesting and instructive pamphlet has been issued by the Standard Paint Co., No. 2 Liberty street, New York, for free distribution, which should be in the hands of all who are interested in car roofing and insulating. It contains valuable suggestions and directions—brief, clear and concise. A postal card request, giving address, will bring a copy to any of the readers of this paper by return mail.

Atlanta and an Enthusiastic Master Mechanic.

Through the courtesy of Mr. L. M. Collier, master mechanic of the Nashville, Chattanooga & St. Louis, at Atlanta, Ga., we have received a handsomely illustrated publication showing up the attractions of Atlanta. The great exposition which will be held in Atlanta in the fall and winter, will attract a multitude of visitors from all over the Union. They will find the city and its surroundings wonderfully attractive. The exposition promises to be a display well worthy of traveling a long distance to see, and the outside attractions are such as few cities on the American continent can offer. The city in itself is a wonder, for it has been built up entirely since the war ended, and built in a most substantial and enduring form. The population is now over one hundred thousand.

The stirring events of the war of which Atlanta and the vicinity were the theatre make that region classic ground, which is hallowed by many a deed of heroism, where brave men fought and died as martyrs to their principles.

Atlanta is one of the most important railroad centers in the country, being the objective point of nine important railways. Several of the companies have their headquarters in the city. All the roads are first-class and have excellent equipment, which is kept in fine condition—better than the average rolling stock of the North and West at present. The only weak point about the railroads, as far as Atlanta is concerned, is the station accommodation. This is very inferior, but a new general station is in prospect which will wipe away all reproach on this point.

Mr. Collier is enthusiastic about the city where he has lived so many years and watched its growth from a village of ruins. He writes: "This is the Promised Land where times never get hard. There are 2,000 men at work on the exposition buildings and grounds, and a twelve-story granite hotel is going up in the heart of the city, to be finished in time for the exposition. Great is Atlanta, a city of 125,000 population, to undertake such an enterprise in the face of the great financial depression that has nearly ruined every other section of our country. Come down, and be on hand on the 17th of September when the ball opens, and we will show you something that will open the eyes of the people of this continent. Go South, young man!"

The latter advice is intended for all our ambitious readers.

Stationary wedges, for driving boxes, have been used by Mr. W. H. Lewis, of the Chicago, Burlington & Northern, for over two years. Speaking on the subject, he said: "We have run engines some eight or nine months before any lining was necessary. I do think that the great trouble with the movable wedge is that engineers do not use the best judgment sometimes in adjusting it, and that some of the ills that engineers report are imaginary. A short time ago, a switch engineer who had the stationary wedges reported that the engine was pounding very badly, and he would like to have those wedges lined up. We found we could not get a piece of tin between the wedge and the box. After that engine was taken out and run a day or two, the foreman asked the engineer how his wedges were. He said they were all right. The fact was that the only lining up that was done was the cleaning up of the rods, and that, I think, is one, if not the main cause of cut wedges—the poor judgment of engineers sometimes in locating as between the driving boxes and between the connecting rods."

A correspondent in Carbondale, Pa., says that the most important object of having the inside flange on a driving box is for convenience in changing the boxes when they get worn, thus obviating the necessity for lining the inside of the hub to reduce lateral motion. This subject was discussed at the Master Mechanics' Convention, and some of the speakers considered the flange of material value as an easy means of strengthening the box.

We are informed by the Balanced Locomotive & Engineering Company, No. 1 Broadway, New York, that they are having built a perfectly balanced compound locomotive with four cylinders, two of these transmitting power through crank axles. The engine was designed by Mr. George S. Strong. The intention is to have thorough tests made of the engine on the locomotive testing plant at Purdue University.

The New York Central passenger department has issued a handsomely illustrated guide to the health and pleasure resorts of the country. It is the Master Mechanics' standard pamphlet size and has over 500 pages. Nearly every page has a picture on it, the greater part of them being excellent half-tones that do full justice to the places illustrated. The book is sent to anyone on receipt of 25 cents, by G. H. Daniels, Grand Central Station, New York.

We learn that the Nicholson File Co., of Providence, R. I., whose output is more than 50 per cent. of the entire file product of this country, have caused to be posted in their three factories—two at Providence, R. I., and one at Pawtucket, R. I.—notices announcing a material advance in wages paid their employés. This increase will affect upwards of 1,000 hands, and on the part of this company was a purely voluntary act.

The following highly creditable performance of locomotives was sent us by Mr. C. E. Cramer, traveling engineer of the Atlantic & Pacific. He says: "I hand you herewith statement of performance of locomotives for month of May, 1895, A. & P. R.R. I believe this is worthy of publishing. 7 engines, over 6,000 miles; 9 engines, over 5,500 miles; 14 engines, over 5,000 miles; 21 engines, over 4,500 miles; 16 engines, over 4,000 miles; 6 engines, over 3,500 miles; 10 engines, over 3,000 miles; 3 engines, over 2,500 miles; 3 engines, over 1,500 miles; 5 made less than 700 miles; total mileage, 405,607; average per engine in service, 4,314. The last eight were turned out of shop after the 18th of the month, which cut the average down considerably. I wish to call your attention to the fact that we have a mountain road, and pay for more miles than the engines get credit for. This is actual mileage. Also, we have the worst kind of water, and wash out engines after each trip."

The Magnolia Metal Co., No. 74 Cortlandt street, New York, report an increase of 33 1/3 per cent. in their sales from 1894 to 1895, and double as large sales for June, 1895, as for any previous month in the past two years. This company are circulating a very interesting illustrated circular, showing half-tones taken from photographs of the running tests of ten different brands of genuine babbitt metal, under various pressures, which they will gladly send to anyone interested in the subject.

A number of New York, Philadelphia and Boston capitalists have formed a company to build a railroad about one hundred miles long through one of the richest districts in Colombia, South America. The intention is to equip the railroad with rolling stock of American manufacture. The president of the company is Mr. S. B. McConnico, 11 Pine street, New York.

The Gould Car Coupler Works at Buffalo were burned last month. The loss was estimated to be about $200,000. The destruction of these works will not interfere with the supply of car couplers.

A correspondent in New York wishes us to publish illustrations and description of electric motors used on the Chicago Elevated Railroad, but we do not have sufficient readers interested in that kind of machinery to justify us in giving it the required space.

All interested in air brakes should send us $1 for "Evolution of the Air Brake," by Paul Synnestvedt. This is a condensed history of power-brake development and shows just what has been done in this line. If some of the men working now on schemes to recharge, etc., with brakes on would read this book it would save them time and money.

Air-Brake Department.

The Wabash Railroad Company's New Air-Brake Instruction Car.

The air-brake instruction car launched last month from the Wabash shops at Moberly, Mo., is probably the most complete in its design and arrangement of all the numerous similar cars heretofore fitted up by railway companies, and sustains the reputation of J. B. Barnes, supt. of motive power of that system, for the thoroughness to which he is so justly entitled.

The car body is 50 feet over all, having been remodeled from a passenger coach, and is mounted on two specially constructed four-wheel trucks of Wabash standard pattern. When loaded, the car weighs about 90,000 pounds. The important matter of proper ventilation has been carefully considered; numerous windows, side and end doors and deck ventilators supplying the "needful." A 14-inch cylinder brakes the car to 90 per cent. of its weight.

The interior of the car is divided into three compartments, viz., office, sleeping-room, and that containing the machinery. The office is a cosy little affair, handsomely carpeted and fitted with writing desk and chairs for the instructor's use. Duplex air gages on the wall indicate the pressures in the train pipe, auxiliary reservoir, brake cylinder and signaling apparatus, which, with the Boyer speed recorder close by, "keep tab" on the engineer as the car is being hauled from place to place. Sufficient space is partitioned off the side of the office for a lavatory, linen closet and wardrobe.

The middle or sleeping compartment is about 7 feet in length, extending full width of the car; it is also handsomely carpeted and contains two standard Pullman sections. Swinging doors open into the office and machinery room.

The instruction room is by far the more interesting, and seems to be crowded to overflowing with useful apparatus and clever devices for increasing the knowledge of the men and improving the service generally.

A 12 H.-P. Westinghouse boiler, seated in a large drainage pan and located squarely over the truck, furnishes steam to the air pumps and engine for driving the dynamo, and is fed at option by either small Monitor or Ohio injectors, or a No. 2 Worthington water pump; the water being supplied from two $\frac{3}{16}$-inch steel, rectangular tanks of 785 gallons' capacity, suspended underneath the car. A Reliable Safety water column, which blows a small whistle when the water in the boiler gets either above or below certain limits, keeps the fireman awake and the instructor's temper sweet. The coal bunker, holding 50 bushels of anthracite coal, sets in one corner, and is nicely balanced by a Westinghouse 5 H.-P. Standard engine and 50-light, compound-wound, multipolar generator, which supplies the light for the 25 incandescent lamps, and also power for the small motor which runs the valve-motion model and the outside-equalized driver-brake model placed on the wall near the middle of the car.

Suitable brackets, fastened to the boiler and drainage pan, support the 9½-inch and 8-inch air pumps. This manner of erecting the pump renders it less noisy than when it is fastened to the wall, as is customary.

A 20,000 cubic inch main reservoir, standing on end, and supporting the B 11, D 8 and E 6 engineer's brake valves, with duplex gages, is conveniently located midway between the air pumps and 20-car freight train, all of which is systematically located on a longitudinal center line, thus keeping the contents of the car evenly balanced.

As the instructor faces his class, he finds, squarely in front of him, twenty sets of freight brakes, vertically arranged, with full complement of piping, hose, stop cocks, valves, etc. Specially arranged cut-out cocks are supplied by which the train may be cut into any length from one car to twenty. On the wall, to his right, is a push-down cam driver brake and 8-inch tender brake with suitable reservoirs and duplex air gages for explanatory purposes. A sectional triple valve works tandem with the tender triple, and offers invaluable assistance to the instructor, and makes comprehensive to the beginner the workings of this heart of the automatic air-brake system. To the left, opposite this, is an ingeniously devised full-size passenger-car brake, with 10-inch brake cylinder, levers and beams complete, set on end to economize space, and only occupies that of the depth of the truck. Beyond this, fastened to a hardwood base, is a half-size working valve-motion model, very neat and clean-cut, run by a small motor whose speed is regulated by a separate controller. This will undoubtedly prove a valuable adjunct to the car, and make its reputation on the performance sheet as a coal-saver. Against the partition, which separates the instruction room from the sleeping apartment, is an M. C. B. letter file and a small refrigerator. Sectional injectors and a nickel-plated triple sight-feed Nathan lubricator adorn the wall. Across the aisle is a Baker heater with jacket system.

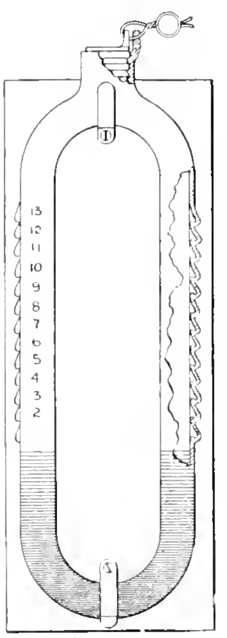
In the clear-story of the car is sufficient piping, hose and valves to represent the full signal equipment for thirteen passenger cars.

Twenty-five incandescent lamps, suitably distributed, light all compartments of the car. A handsome oak switch-board, 4 feet square, mounted with ammeter, voltmeter, circuit breaker, rheostat and lamp switch, and located near the dynamo, completes the electric outfit. Eight Adams & Westlake oil lamps, located as usual, may be used instead of the electric lights if desired.

The wood work of the interior of the car is painted white, and the iron Tuscan red, giving a very pretty effect, and is a relief from the customary somber black. Mr. M. R. Contant has charge, and will make regular tours of the system with the car. Success to the Wabash Boreas!

Device for Registering Shocks on Passenger Trains.

The following illustrated device was patented by Henry Brown, engineer on the B. & O. Ry., for the purpose of registering the amount of shock incident to the rough handling of passenger trains, such as an emergency application or failure to release at the proper time, etc. It consists of a glass tube, 1 inch in diameter, with a number of pockets on each side. The lower part of tube is filled with a colored fluid, and hung in a bracket on inside of baggage car or some other designated place. It is examined by the inspector at each terminal, and record taken of highest number of pocket with fluid in. For instance, if fluid will show in pocket No. 4 for ordinary handling of train, and fluid is shown in pocket No. 8, an explanation will be required as to cause of heavy shock to train, causing fluid to splash into No. 8 or No. 9 pocket.



"Rat" Hogan spent fifteen years running an engine on the P. T. & L. J. R.R. (Pine Ties & Low Joints R.R.) before coming to the trunk line which now employs him. During his entire career as an engineer he has been accustomed to blame all delays to "stuck brakes." Train dispatchers knew just what excuse would be forthcoming when they took him to task for not making time. Not until last winter did "Rat" learn, from talking with the other boys, that "stuck brakes" were caused by making too many applications without recharging, and otherwise wasting the pressure, and not the fault of the brakes. Then he took a tumble to himself, and has had no "stuck brakes" since.

Last February, during the blizzard, the

dispatcher got after "Rat" for losing time, and, noting the absence of the old-time excuse, sarcastically asked if the air brakes were not stuck "Rat" replied with the following, which almost cost him his job:

"The weather is cold and the steam is low,
The train is heavy and hard to tow,
The coal is bad and full of slate,
And that, not stuck brakes, makes Sixteen late."

If you want to confer a favor on your air pump do not "dope" the air cylinder with oil, but make a swab of candle wick which will fit the piston rod and fill the space between the gland nuts. This will hold oil and moisture which will lubricate the packing in the stuffing boxes, and distribute it to the air cylinder as well. You will not need to pack the rod so often, and the pump is less liable to run hot and burn out the packing. Don't screw down the gland nuts too tight; that is one thing which makes a pump run hot.

No greater improvement can be more easily made in the air-brake service, or an engineer's reputation as an air handler bettered, than that had by him who acquires the knack of releasing his brakes a sufficient distance before coming to a full stop, to avoid the customary disagreeable shock to passengers. Train crews and the traveling public notice this and comment upon it. Practice this, and see if you cannot prevent your driving wheels from making that short backward movement after stopping.

Don't think there is anything mysterious about the air brake and its actions. There is nothing mysterious, except to those who do not understand. Study up the air brake and its operation, and be able to require every action to give an account of itself. The superstitious are the only ones who ever saw a ghost.

S. D. Hutchins, president of the Air-Brake Men's Association, gives some very good advice in another column to those who would decrease the number of slid flat wheels and improve the handling of passenger trains generally.

The monkey-wrench cure—hammering on the head—for sick air pump has been found to kill twice where it cured once, and has been abandoned by all doctors who have diplomas; a few quacks still use it.

On most new engines the pumps are being placed on the left side of the boiler. There is getting to be so many implements and instruments on the right side that they were in the way; the removal of the pump helps to equalize things a little.

Why the "Double Application" and "Kick-Off" Resolution Did Not Pass.

Editors:

As the articles in June and July numbers of LOCOMOTIVE ENGINEERING, by Messrs. Alexander and Synnestvedt, referring to two applications, "kick-offs," etc., will not be clearly understood by some of your readers, I would like to say, in explanation, that the Air-Brake Association did not advise that two applications or "kick-offs" be used to prevent wheel sliding on bad rail. Mr. Synnestvedt did introduce a resolution to that effect, but it was voted down by a large majority, for the reason that, while it contained a certain amount of merit, it was nevertheless inadequate and incomplete, and more likely to lead to troublesome complications than to effect any practical good, as will be proven by a careful canvass of the causes of slid flat wheels. The recommendations of the committee, found on pages 128–130 of the report of the proceedings, and the use of sand, as brought out in the discussion following the reading of the paper, if followed out, will leave very little, if any, work for such a resolution to do.

I do not believe in "kicking off" brakes, and never do it, for the reason that it is uncertain, and that varying conditions may cause some brakes to remain set; and when the second application is made, such brakes, being applied fully, and assisted by the conditions referred to, will increase the likelihood of sliding. I believe it is almost an impossibility to break a passenger train in two by "kicking off" brakes, for the reason that the close couplings stand a much harder jerk when the engineer "slacks" a long train out of a hard place to start, than that had by "kicking off" brakes.

On roads where accurate records of slid wheels are kept, I am afraid Mr. Alexander would find himself alone in his belief that more sliding is done by engineers who make but one application to stop, unless they hold their brakes on until they come to a dead stop. The timely release of brakes will do much to prevent wheels from sliding, as well as do away with the shock resulting from holding the brakes on until the train stops. The damage is done usually in the last few feet of the stop. I have been in the harness, pulling a passenger train for the last fifteen years, and have never had a slid flat wheel recorded against me.

My practice has been to make a reduction of 4 to 6 pounds, to get the brake-cylinder pistons past the leakage grooves and bring the shoes up to the wheels; then I follow up with reductions such as speed and distance cause my judgment to dictate, aiming to make the stop with one application, and to have the brakes off by the time the train stops, and avoid the lurch. If the rail is bad, I begin to use sand as I begin to apply brakes. I make it a point to know that the sand in my box runs, and that the pipes deliver it to the rail. *This is practice.*

It has been my experience that it is not the engineer who dashes into the station at the highest speed that always makes schedule time. Considerable time is often lost in unloading passengers at stations, and the engineer who makes a smooth stop will find his passengers in the aisle ready to unload; while the engineer who makes an initial reduction of 8 to 12 pounds will have his brakes on full on a well-adjusted train, with nothing to come or go on, and will make a stop closely bordering on an emergency stop. He will also find his passengers nervously clinging to the seats until the train stops, awaiting the almost inevitable shock which this style of braking teaches them to expect; then they gather up their bundles and baggage and begin to unload. Slow train crews make it hard to make time on fast local schedules. Over-swift engineers will find that backing up or pulling ahead a trifle, as they will frequently be required to do in making these short, fierce stops, will make it exceedingly difficult to make schedule time. Coolness, a reasonable exercise of good judgment in calculating speed and distance, timely release of brakes to prevent the lurch, and judicial use of sand, will allow an engineer to make fast time, do smooth braking, and have few, if any, flat wheels recorded against him.

S. D. HUTCHINS.

Columbus, O.

Air-Brake Mysteries.

Editors:

There is an idea prevalent with many, especially amongst the uninitiated, that there is something very mysterious about the action of the air brake. When anything goes wrong, and trouble ensues, such people scratch their heads, endeavor to look wise, pretend to be thinking, and ultimately give up the problem as unsolvable.

There is no mystery about the air brake. It is a plain, simple and easily understood mechanical device, provided it is approached in the right way. The right way is to look at the system as a whole, and not cloud the mind by trying to imbibe a mass of details, before getting a clear perception of the general principles involved.

We often hear of some "peculiar" action of the brake. In the truest sense there is no such thing as a "peculiar" action of the brake. The word "peculiar" denotes something out of the natural order. It is not out of the natural order for a brake to stick if the unnatural cause which makes it stick is present, and the action of the triple might more properly be considered "peculiar" if the brake refused to stick under conditions which should make it do so.

All who have acquired the A B C of air brakes know that, with the automatic

brake at present in use, the application of the brake is secured by a reduction of pressure in the train pipe, and it is released by an increase of that pressure. Very well, then; if a brake is found to be setting when it should not do so, it is clear that the train-pipe pressure is being reduced in some unlawful way. The thing to do then is to examine the conditions, and see if the reason for this unlawful reduction cannot be found. There are two ways in which it could take place, *i. e.*, leakage and equalization. The next thing to do is to find out, if possible, in which of these two ways the trouble arises. The best way to do this, perhaps, is to watch carefully a couple of applications and releases of the brake, and see if, after the pressure in the train pipe, as shown by the train-pipe pointer on the gage, has come to a state of rest or equalization, the air continues to escape. Another thing to be noticed is whether the resetting of the brakes affects all the cars, or only those on a single car or part of the train. If all the brakes are affected, then leakage is unquestionably the cause, in which case the gage will indicate the continued falling of the air pressure, as mentioned above. The leak must then be located and stopped, which will end the trouble.

To some this talk will seem like a waste of words, as the proceedings described would, of course, be the most natural ones to a man accustomed to using his own thinking machinery. It is well to remember, however, that not all men have enjoyed the advantage of learning to use their own brains, when yet many may have the ability to do so if properly instructed. The first step necessary in such instruction is to clear the student's mind of all ideas of mystery, and let him see for himself that there is a reason for every so-called "peculiar" action encountered in the operation of the automatic brake, and, in fact, the operation of any mechanical device; and the only successful way to overcome difficulties such as are encountered in all lines of work on a railroad, is to guide the work of the hands by the use of the brains. Never try to guide the brains by means of the hands, for such an endeavor will inevitably result in humiliating failure.

PAUL SYNNESTVEDT.

Chicago, Ill.

No Communication Between Chamber D and Train Pipe.

Editors:

Having had some experience with air brakes, I would like a word in the discussion between Messrs. J. J. Plunkett, Conger and Ward.

It is well known by air-brake men that the piston packing ring in piston 17 and triple-valve piston is not absolutely tight, and cannot be made so. When brake-valve handle is on lap position, testing brakes for leaks, a leak in train line will show on black hand of gage. As Mr. Ward well says, when handle is on lap position all communication between train pipe and gage is cut off, and if piston 17 were absolutely tight any leak in train line would not indicate on gage.

Some time since I had some trouble with brake-valve piston 17; it would not rise when a preliminary exhaust was made and train-line gage pointer would fall very slowly. In looking for the trouble, I found the preliminary exhaust port partly stopped up. After cleaning this out and applying the brake the piston 17 would rise, and black pointer would fall very much faster than before, indicating to me that, if from any cause piston 17 fails to rise, or only rises partially, air flows by piston 17 enough to keep chamber D partially charged.

I have frequently tried Mr. Conger's experiment of exhausting air from train line with brake-valve handle on lap, and black pointer always falls, and if left long enough will fall to zero.

In answer to Mr. Ward's question in July number, a broken graduating valve or spring will cause an emergency application after a 5 or 8 pound service reduction has been made, for the reason that if graduating spring is weak or broken there is nothing to stop piston 4 from making its full travel, thereby uncovering emergency port *t*, unseating valve 10, and allowing air to flow from train pipe to brake cylinder through check valve 12. This reduces pressure in train line and causes other triples to operate in the usual manner. If graduating valve is broken, it will not open to allow auxiliary reservoir air to flow to brake cylinder; consequently, the same movement of slide valve will take place as is caused by a weak graduating spring, for the reason that a reduction of 5 to 8 pounds pressure in train pipe, if there is no immediate escape of pressure from auxiliary, will force piston 4 to its full travel.

I would like to ask air-brake men why Mr. Westinghouse does not have a port in valve to indicate on gage what reduction is made in an emergency application of the brake?

B. F. FOX.

Fort Dodge, Ia.

The Automatic Independent Driver Brake.

Editors:

Inasmuch as there has been considerable agitation of the question of independent driver brakes, I think the device I herewith describe will satisfy the main requirements of an independent driver brake, and at the same time retain its automatic action whenever train breaks in two or engineer's valve is used.

A small ½-inch plug cock is placed in the pipe leading from the main train line over to the driver-brake triple valve.

In one side of this cock a small $\frac{1}{16}$-inch hole is drilled through to the center of cock, and then plug is turned half way around. Connect a handle to this ½-inch plug cock, extending the handle up near to engineer's valve, where it is handy. By turning this handle one-quarter way around, the driver brake is applied, because the air from the branch pipe escapes through the side $\frac{1}{16}$-inch hole in the cock.

No one I ever saw doubts that a mixed train (part air cars) can be handled easier by an independent driver brake; yet several decisions by coroners' juries have been adverse to the railroads, on account of the non-automatic independent driver brakes. Also, there is danger of engine and tank parting and killing the firemen, when a hose bursts on a train with ordinary independent driver brakes.

This little device has been in use on some of our engines with great success for over a year. The men like it and approve of it. It tends to the keeping-up of a better driver brake, which is sadly needed on most roads.

A great many well-posted railroad men have examined this device, and can offer no objections, while they would not countenance an entirely independent brake for a minute.

I would be pleased to have the friends and enemies of independent engine brakes who read LOCOMOTIVE ENGINEERING offer their criticisms of my automatic independent driver brake.

EDWARD W. PRATT, M. E.,
Gen. Air-Brake Ins., C. & N. W. R.R.

Chicago, Ill.

[That all air brakes should be coupled up and used continuously has been forcibly proven in the past to be the proper thing. Any combination which requires a separate handle, or otherwise operates separately from the other brakes, is a menace to life and property, as the possibility of it not being in proper combination at critical times is always present. An independent driver brake may be permissible in some very few isolated cases, but should never be allowed in general practice. The ends sought by its use are obtainable in other and more legitimate ways, which do not conflict with safety at any time. As a gatherer of slack in a partially equipped air-brake train, it would prove a great disappointment after the novelty had worn off, as it is quite possible to get a much severer shock on the rear end from slack gathered by a careless engineer with an independent driver brake, than that had by a judicial reduction with a continuous brake on engine, tender and small number of air-brake cars.

With due credit to those whose genius has developed novel features in the independent driver brake, we cannot but refuse our allegiance to a legally ostracised parasite, which only accomplishes that which should be obtained by other expressly designed means.—ED.]

Queer Antics of a Tender Brake.

Editors:

On an engine running out of this city, it was found that upon opening the blow-off cock, thereby permitting the steam and hot water to blow back under the tender, the tender brake applied.

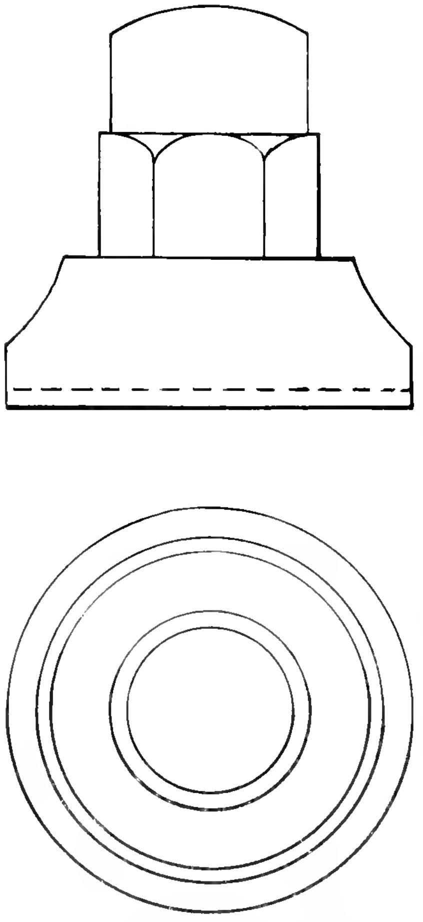
The auxiliary reservoir was located crosswise of and about the middle of the tender. What caused the brake to set?

Chicago, Ill. GEORGE B. SNOW.

Vise for Holding Packing Rings.

Editors:

The inclosed cut is an old reversing cylinder cap, connected into a vise for holding main valve and reversing piston packing rings for filing. Of course, it will be necessary to have a separate cap for the reversing piston rings, as they are so near the same size; you can't get them all on the same one.



I also have two wood blocks grooved the same way for holding steam and air piston rings. With these tools you can fit a whole set of rings while you are getting ready to fit them the "old way," and there's no danger of breaking them while filing.

Paducah, Ky. S. W. DODDS.

Please send in matter for this department early in the month.

We want you to feel that this department is *yours;* use it to obtain any air-brake information you want.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(7) T. H. N., Decatur, Ill., asks:

What is the difference in the braking power on a 33-inch wheel with a shoe 17 inches long by $3\frac{1}{4}$ inches wide, and one 13 inches long by $3\frac{1}{4}$ inches wide, with the same power applied to each, or is there any? *A.*—There is a difference in favor of the longer shoe, but just how much would be determined by the frictional qualities of the metal composing the brake shoe. The retarding force of a brake is not governed alone by the pressure delivered by the levers, nor by the length of shoe. The frictional qualities are very great factors. Soft cast iron gives the highest co-efficient.

(8) F. P. R., Denver, Col., writes:

Can you give me any information as to what has been done in the line of an air-brake triple that will recharge with brake set? If not, can you tell me where to apply for the desired information? *A.*—Several designs of triple valves which recharge the auxiliary reservoir while the brake is applied have been patented in the last ten or twelve years. Some of these designs require an additional train pipe, while others are quite ingenious and have succeeded in accomplishing the object sought by making the entire change in the triple, using but one pipe. Serious objections have been found to this form of triple in practical service, and the retaining valve does the work more satisfactorily. The Patent Office Reports would give you all you wish on this subject.

(9) H. B., Galion, O., writes:

I would like to know why there is such a great difference in the opinion of the several authorities in regard to pounds pressure on the brake piston had by certain reductions in train pipe. For instance, the W. A. B. Co. Instruction Book says a 7-pound reduction gives 4 pounds pressure in brake cylinder, and 9 pounds gives 19 in cylinder. Rogers, in his "Pocket Primer," states that a reduction of 5 pounds from 70-pound train pipe will give $12\frac{1}{2}$ pounds to the square inch on the brake piston. Please explain. *A.*—The W. A. B. Co.'s figures are correct. Mr. Rogers has evidently not intended that his figures should be taken literally, but has used them to make clear the fact that 20 pounds reduction applies the brake full, or gives 50 in the cylinder. Thus 10 pounds reduction would give 25, and 5 would give $12\frac{1}{2}$ pounds, were the ratio constant, but it is not, and Mr. Rogers' figures are therefore incorrect.

(10) J. R. E., East Mauch Chunk, Pa., asks:

(1) If the reversing slide valve (No. 16) of the Westinghouse 8-inch pump were cut, would it not cause short stroke or dancing? (2) How can I remedy my pump discharge pipe from running hot, and what is the cause? *A.*—(1) The valve must necessarily be very badly cut, and the passage from the steam pipe to the reversing slide-valve chamber would have to be pretty badly clogged up to make a combination with the slide valve to do this. (2) Insufficient lift of air valves, piston packing rings too small or not fitting the air cylinder, and discharge pipe partially clogged up with gum and burnt oil, caused by using too much or inferior oil in air cylinder, are the principal causes. The first two causes may be remedied in the shop; the latter you may remedy by mixing a bucket of strong lye water and running it through your pump, drawing it in at the suction valves and off at the main reservoir. Repeat this several times, running pump very slowly; then wash out with clean water, oil well with good oil, and use less hereafter. Try a candle-wick swab on the piston rod.

(11) J. H. L., Cleveland, O., writes:

In Question 88, June issue of LOCOMOTIVE ENGINEERING, there seems to be a misunderstanding. To the question asked by P. McL., Fulton, Mo., I would say that the black pointer registers pressure in the small reservoir alone, and no other place, except incidentally. For instance, brake-valve handle is in release position. Pressures in small reservoir and train pipe are equalized. Gage registers small reservoir pressure alone, but our knowledge tells us that the train-pipe pressure is the same. With handle on lap, and pressures equalized, the same knowledge tells us what the pressure is in the train pipe, *but only incidentally*, as the gage is connected to small reservoir. Take a train of 20 cars charged up. Draw off 10 pounds from gage in "service application" position, and then lap valve. *At this instant gage does not even incidentally show pressure in train pipe, nor does our knowledge tell us.* As soon as the discharge at the train-pipe exhaust ceases, then the gage, incidentally, and our knowledge tell us what the train-pipe pressure is, for it has equalized with the small reservoir pressure. [You are right.—ED.]

(12) J. M., Americus, Ga., writes:

I wish to know the difference between a feed valve in D 8 and the improved D 5 Westinghouse equalizing, discharge brake valve, and what ports in seat and rotary valve are changed? *A.*—The feed valve, or "excess pressure" valve, as it is sometimes called, supplies pressure from the main reservoir to the train line when handle is in running position on the D 8 pattern, but not until 20 pounds, or a pressure equal to whatever the tension of the feed-valve spring may be, has first been accumulated in the main reservoir. Thus an excess pressure is accumulated which insures a release of all brakes. The feed valve in the D 5 pattern is held open by a stiff spring under a piston which has train-pipe pressure on top of it. The adjusting nut gives a tension of about 70 pounds to the spring, which will hold the feed valve open until the train-line pressure a little more than equals it, when it will seat, and cut off the feed until such time as leakage or other causes may reduce the pressure below the tension of the spring, which, then being greater, will unseat the feed valve, and admit pressure from the main reservoir until it again reaches 70 pounds, when the feed valve cuts off supply. The feed valve in D 8 pattern will not open until 20 pounds has first been accumulated in the main reservoir, or is held that much in advance of train-pipe pressure. That in D 5 is always open when pressure is less than 70 pounds in the train line, and closes when that pressure is reached. The ports in the two valves are quite different. See the Westinghouse Instruction Book.

On the Fall Brook road the conductor is obliged to send in a report of every case of break-in-two and state what caused it. This report has cured half the trouble—the boys are more careful with the brake and the throttle. Most cases now are on account of bad draw gear or defective timbers.

PRACTICAL LETTERS FROM PRACTICAL MEN

The Counterbalance in Locomotives.

Editors :

In your description of the Schenectady locomotive for the Montreal Railroad, in the July number, you refer to the special care taken to reduce the evil effects of counterbalance, and mention, among other things, light crank pins and wheel centers.

I am quite conscious of the fact that a man accustomed to stationary practice endeavoring to criticise locomotive practice is liable to get out of his sphere, but if you and the Schenectady locomotive builders are right, then we of the stationary practice are off in our notions, and the mathematicians in their mathematics. According to our understanding and practice, a locomotive with crank pins weighing a ton, with counterweights opposite to balance, would give no more hammer blow on the track than if they weighed a pound, and that pound counterbalanced.

As to the light center drivers, is not that exactly the wrong thing to do? If there is any place where the anvil principle in mechanics will best apply, is this not the place? If by any scheme an anvil can be interposed between the hammer blow and the track, would it not be the same as interposing an anvil between a sledge blow and anvil block, and can anything be done that will more nearly approach that than heavy driving wheels?

Again, if a locomotive needs to be loaded to get the necessary weight for traction (which, likely, it never does), then it seems to me that the driving wheel is exactly the place to put it, as it puts the same additional pressure on the track, but none on the axle boxes. As I have carried my comparison to an extreme, so, too, could this question be settled (if it has not already been settled) by carrying the weights to the extreme. To secure traction alone, that can be carried to any extent by piling pig iron in the wheels—possibly, however, to the destruction of the track on account of absence of springs; but so far as the hammer blow from counterweight is concerned, the heavy wheels, according to our theory, ought to be better than light ones.

Certainly, the light crank pins can have no effect except to lighten the whole structure, for the effect of the weight of pin crank end of connecting rod and the side rod are the same as if all were concentrated at the pin with a lump opposite to balance it, when all would be simply the same as so much fly wheel and have no disturbing influence.

The counterweight that balances part of the connecting rod, crosshead and piston is the only part that hammers the track, according to the stationary engineer's theory.

The locomotive is a marvel of mystery to delvers in the stationary practice, probably because we cannot comprehend the relation the driving wheels bear to the frame and masonry foundation of a stationary engine. JOHN E. SWEET.

Syracuse, N. Y.

A Handy Bolt Driver.

Editors :

I inclose you sketches of a bolt driver that, once used, will cause the disappearance of the solid bolt, the driver, and make that nuisance an obsolete article. Every lathe hand has been annoyed by getting a batch of bolts to turn, with heads of various sizes, and would either file out the driver or file the bolt head a little.

With this little kink it will not be necessary to do that, and any size, from $\frac{1}{64}$ inch up to 3 inches or more, can easily and quickly be adjusted. I think the drawing will explain itself. Drill two $\frac{13}{16}$-inch holes on face plate to receive the bolts; the driver can be adjusted to suit length of lathe center, either by putting washer between face plate and driver or taking them out, as the case may be.

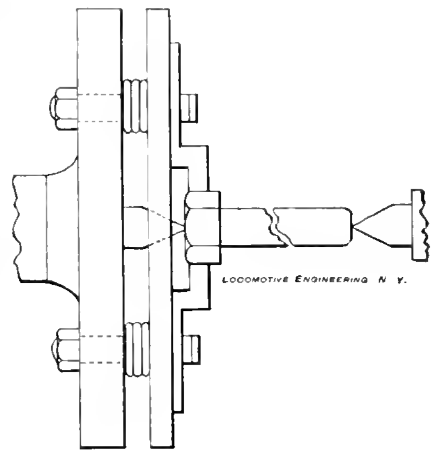
Put driver on face plate, letting lathe center pass through hole in center of driver; tighten nuts up with fingers, put the bolt in lathe and press jaws against bolt, then tighten nuts with a wrench, and you are ready for business. The little square notch in jaws is to be used when turning any small set screw from $\frac{3}{8}$ inch up to $\frac{3}{4}$ inch.

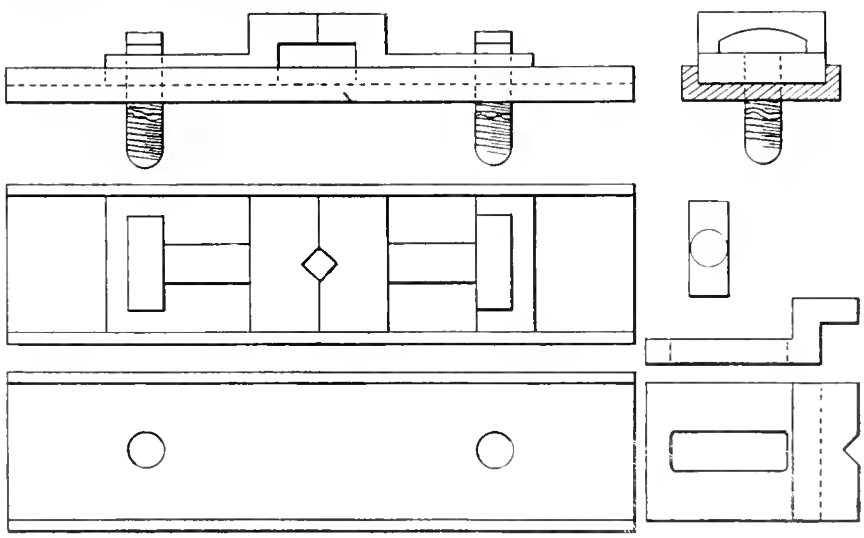
This is an inexpensive tool to make, and will soon pay for itself.

Yours truly,

W. T. RUPERT, M. M.,

Ionia, Mich. D., L. & N. R.R.





Polish Inside Cylinder Heads.

Editors :

The interesting article entitled "Economy in Locomotive Repairs," published in LOCOMOTIVE ENGINEERING for July, contains valuable information relative to the method adopted by Superintendent of Motive Power Frank Reardon, of the Missouri Pacific Railway, for reducing the cost of locomotive repairs by eliminating all unnecessary machine work upon the cylinder heads and steam-chest covers.

That there is much unnecessary work done on many locomotives is beyond question, and all efforts made to reduce this needless expenditure of time and money

are highly commendable, still, this policy may be carried to excess, and the unqualified statement in the article above referred to, that "as the inside face of cylinder head touches nothing, no good reason could be found for machining that," can hardly be accepted as good practice or true economy, in view of the existing reasons for the belief that rough cylinder head and piston surfaces increase initial condensation to an appreciable extent, especially in the low-pressure cylinders of compound locomotives. In order to understand the influence which rough cylinder head and piston surfaces may exert upon cylinder condensation, it must be remembered that at all times, part of the initial steam in a locomotive cylinder is condensed, through contact with surfaces which have been cooled by the exhaust steam of the previous stroke, and is deposited in a film of infinitesimal thickness upon the cylinder walls, piston and cylinder head.

During the latter period of expansion, but chiefly at release, the pressure of the expanding steam falls below that of saturated steam at a temperature of the cylinder and piston surfaces, and consequently the film of water upon the latter is re-evaporated, and escapes to the atmosphere or the low-pressure cylinder, carrying with it the heat it has abstracted from the cylinder walls, etc., and reducing the temperature of those surfaces. From this it is evident that, with any given set of conditions, the greater the re-evaporation the greater will be the cooling of the cylinder and piston surfaces, and, therefore, the greater will be the condensation of the steam entering the cylinder at the beginning of the stroke. The re-evaporative power of a body at a given temperature obviously increases with its area, from which it follows that, in order to minimize the re-evaporation in the cylinder of an engine, the piston and cylinder heads should be turned and polished, since the rough surfaces of these parts, especially when they are of cast steel, are capable of increasing to an enormous extent the area exposed for the conduction of heat to and from the working steam.

In a recent paper on "Working Marine Engines at Reduced Powers," read by Mr. D. Croll before the Institution of Naval Architects, England, the author, in speaking upon this subject, says: "Passing to the rough surfaces of cast iron and steel, we may easily conceive that an almost imperceptible difference in the conformation of the surface may make an immense difference in the area exposed to the steam. Consider an element of piston area inclosed in an equilateral triangle; suppose equilateral triangles to be raised upon each of the sides and joined at the top to form a tetrahedron; it is evident that the area now exposed will be three times that of the original triangle. This is true, no matter how small the areas involved. A little consideration will show that the principle involved in this rudimentary case can be largely extended if we choose to build up other forms and make surfaces analogous to, say, coke, or even the rough, rasping surface of some steel castings. With these considerations before me, it struck me forcibly that in my own practice the most economical results were obtained with cast-iron pistons and covers, and the worst with those made of cast steel. Upon inquiry among my engineering friends, I found that those engines which were troubled with water in the cylinders had cast-steel pistons, and in cases where covers and pistons were of cast steel it had occurred that no diagrams could be obtained through the wetness of the steam. Personally, I was troubled with a low-pressure cylinder which would hardly give cards, and I thought I should cure it by smoothing the steel piston with some kind of varnish. Having succeeded in getting a composition which was said to stand the temperature, I thought it advisable to try some experiments on a small scale, and made a hollow cube of brass sheets about $\frac{1}{16}$-inch thick. One side was polished and the other covered with the varnish. The cube was then filled with water at different temperatures, varying from 105° to 140° Fahr.; a jet of steam was turned against the faces of the cube, and when a film of water was deposited, the steam jet was turned off, and the time noted that was required to re-evaporate the film. The mean times were, respectively, 368 seconds for the polished surface, and 128 seconds for the varnished one. The great difference in the re-evaporative power of these two surfaces was to me incomprehensible, until the chemist who had supplied me with the varnish pointed out that, under the influence of the heat applied, the varnish would crack into an almost infinite number of minute fissures, and thus present an enormous surface for re-evaporation, although the varnish remained apparently smooth. A more conclusive experiment appears to be the following: A cylindrical cast-iron cup was bored out till the thickness of the metal was about $\frac{1}{8}$ inch; part of the outer surface was left as it came from the mold, and another part opposite was polished. The cup was filled with water of temperatures from 170° to 180° Fahr.; and it was found that the mean times required to evaporate the water from the steam jet condensed upon the surfaces were, respectively, 43 seconds for the rough and 83 seconds for the smooth face."

In summarizing his argument, Mr. Croll says: "As far as can be seen from the above experiments, a polished surface is far superior to that of ordinary cast iron as it comes from the mold, and a rough steel casting is probably about the worst material that could be chosen. It appears, therefore, advisable to carefully turn and polish, as far as possible, all parts of the steam cylinder which come in contact with steam performing work. * * * In my experience, excessive condensation has always occurred in combination with rough steel pistons and covers; in one case this was so marked that the top of piston would not give a card at all, which I attribute to the cover being of rough cast steel, and combining with the top of piston to absorb the heat of the steam. * * * The highest results known to me are obtained by the carefully designed land engines of Messrs. Sulzer, of Winterthur; the pistons and covers are carefully turned and polished, and a consumption of 11.73 pounds of steam per indicated horse-power has been obtained with their triple-expansion, vertical type of engine. These considerations lead me to the conclusion that, if we wish to make really high-class machinery which will give the highest results in economy, we must turn and polish the surfaces of pistons and covers, or else seek a method of coating these surfaces with a metallic layer which will diminish their tendency to absorb and reject heat."

Mr. Croll's deductions, as quoted above, are, of course, particularly applicable to triple and quadruple expansion marine engines, in which the diameter of the low-pressure cylinder being approximately 1.5 times the stroke, the piston and cylinder head areas are some 50 per cent. greater than the working surface of the cylinder barrel. Then, too, the comparatively slow piston speed of marine engines gives time for the transfer of the heat in the metallic surfaces to and from the steam; and the ratio of compression being usually less than that in locomotives, the ends of the cylinder are not re-heated before admission to the same degree.

On the other hand, single-expansion locomotives with 20 x 24-inch cylinders, and compounds having 29 x 24-inch low-pressure cylinders (the total head and piston areas of which are 1,256.64 and 2,642.08 square inches, respectively), are by no means uncommon; and since the majority of these large-cylindered engines are in freight service, where the average piston speeds and ratios of compression approximate somewhat those found in modern marine engines, the conditions are not so dissimilar as might at first sight be supposed.

I am well aware that extreme caution must be exercised in applying to locomotives the conclusions drawn from experiments on marine engines, but the results of Mr. Croll's investigations of the relative evaporative power of rough and polished surfaces are so striking, and the condensation he observed in engines having rough cast-steel pistons and covers was so excessive (in one case rendering it impossible to obtain a card at all), that it appears highly probable that rough piston and cylinder-head surfaces diminish the efficiency of a locomotive to an appreciable degree, especially in the case of compound locomotives in freight service, where the conditions approximate more closely to those characteristic of marine engine practice.

Until very recently the cylinder heads and pistons of American locomotives were universally of cast iron. Lately, however, the question of the injurious effect exerted by heavy locomotives upon the rails has been much discussed by engineers in this country, and as a result there appears to be a commendable tendency among the more progressive locomotive builders to make these parts of cast steel, in order to obtain the maximum amount of grate and heating surface with the minimum weight on the rails. As pointed out by Mr. Croll, a rough steel casting is probably about the worst material that could be exposed to steam performing work in a cylinder; hence we should be careful that our efforts to reduce the cost of locomotive repairs by neglecting to machine the piston or cylinder-head surfaces do not, in the end, result in a case of "dear cheapness."

Of course, when the practice of rigid economy in locomotive repairs is imperative, a master mechanic is always compelled to sacrifice much work which he would gladly do were he financially able; still, from what has been said, the inside surfaces of a locomotive cylinder do not appear to be the proper field for the exercise of economy in machine work.

EDW. L. COSTER.

10 Wall Street, New York.

More Evils in Full Throttling.

Editors:

The article on uneven tire wear in the July issue of your paper induces me to make a parting reply on the subject, as I suppose I am among the correspondents alluded to. I believe I was the first to lay the cause of uneven tire wear to full throttling; and when I did so, I expected I would not recognize myself after the critics got through with me. But so far, I believe the evidence is on my side. The article alluded to states that the expense of turning tires is a small item compared to the amount of coal consumed. I wish to say that the cost of turning tires is also a small item compared to the other repairs made necessary by full throttling, for I believe the damage is universal, which begins at the cylinders and ends at the foot board. However, I do not oppose full throttling; high speeds, under some conditions, make it necessary.

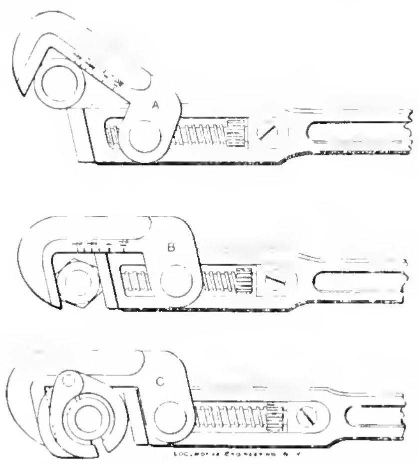
Whistler, Ala. D. O. SMITH,
Master Mech., M. & O. R.R.

Engine 514 of the Denver & Rio Grande Railroad, a ten-wheel passenger engine, built by Baldwin—cylinders, 18 x 24 in.; drivers, 54 in. — made 177,000 miles in passenger service since last general overhauling, which was June 22, 1891. This engine runs between Denver & Pueblo; engineer, William King.

Is there anyone getting subscribers for this paper in your district? If not, write us for cash commission.

A Sensible Wrench to Take the Place of Other Wrenches on a Locomotive.

For a long time there has been talk about the expense of tools on locomotives. At two separate meetings of the New York Railroad Club this question was up and earnestly discussed. It was agreed that two sizes of monkey wrenches were necessary, but many favored one 15-inch wrench. On passenger engines it is necessary to carry some kind of a pipe wrench to hold pipe and fittings in repairing emergency break-downs to steam, heat or air systems. It is well known to railroad men that the reasons why ordinary monkey wrenches go to pieces so fast is the abuse they get and the weakness of their construction. A broken handle shank, or even the wood handle coming off, ruins a wrench. Nine men out of ten pull a wrench the wrong way, tending to spring the jaws and ruin the wrench. Look into the tool boxes of two-thirds of the locomotives in the country, and you



will find monkey wrenches that have been used as hammers and spoiled.

We wish to propose for locomotives a wrench that cannot be used as a hammer, that will fit any nut, and by turning it over is made into an S wrench—on account of the angle of the jaws—a wrench that can't be used the wrong way, and one with an unbreakable handle.

This wrench will answer for every need on a locomotive; a scale on the solid jaw shows just where to adjust it to fit a given size of pipe. It is made of steel drop forgings throughout, with ample bearings, and is practically unbreakable.

For the rough work of locomotive service, we think it would be an improvement over monkey wrenches, and take the place of both them and a pipe wrench. A cast clamp is furnished with it to use on copper and brass pipe without marring them.

This is no puff for an advertiser—the makers do not advertise with us—but the tool is a good mechanical job and deserves attention. Used in connection with a keystone ratchet wrench—which is made in Buffalo—all other wrenches—solid, socket, pipe and monkey—could be taken off locomotives. This wrench is made by Samuel Hall's Son, of this city.

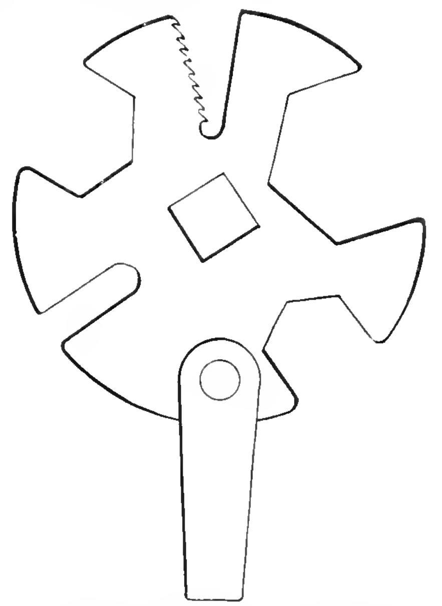
Encourage the Associations.

The annual address of President Garstang, at the last Master Mechanics' Convention, was highly sensible and practical. Nearly every paragraph of the address contained ideas well worth quoting, but we were particularly pleased with the following:

"I wish to ask your encouragement for those who are members of the Traveling Engineers' Association, Master Car and Locomotive Painters' Association, Association of Railway Air-Brake Men, and kindred associations, as these are good educators in their special line of work, and directly are a benefit to the railways. For several years past I have encouraged the attendance of those with whom I have been associated, who are members of these associations, and I would suggest the same be done by members of this association."

An Engineer's Pocket Wrench.

The outline sketch shown herewith explains the construction of a pocket wrench made by Mr. Rohrbach, until recently roundhouse foreman of the Central Railroad of New Jersey, at Centreville, N. J. It has three openings for hex. nuts that



fit as many kinds of oil-cup tops. The square hole in center fits a set-screw head; the alligator will grip any small pipe or feeder; the narrow opening next the screw-driver is for the flat drain plug on lubricators, and the screw-driver is always handy in adjusting feeds, folding out of the way when not in use.

On the Fall Brook road they are hauling a good many of the new-style high and short gondolas of coal. The men have given them a very appropriate name, "Bald-headed box cars."

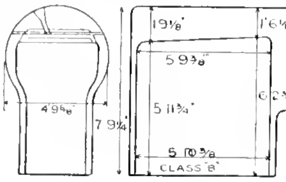
Don't miss your paper several months before letting us know. We are anxious that you get every copy, and will try to correct any fault.

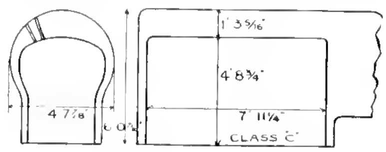
The Expansion of Firebox Sheets—Some Experiments.

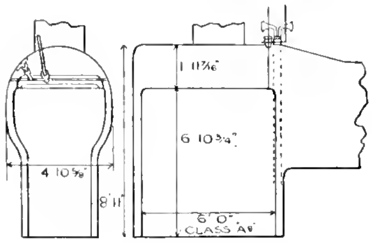
To determine the amount of expansion of firebox sheets, and the difference in amount and time between the movements of the firebox and shell sheets, Mr. J. M. Boon, assistant superintendent of motive power of the West Shore road, recently completed some interesting experiments.

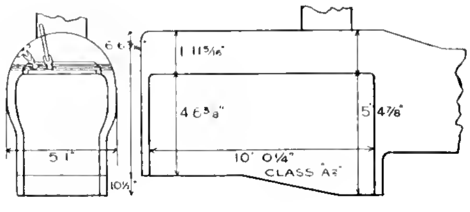
He selected four types of boilers having the greatest range in size and design, as shown in our engravings.

He then built a frame of heavy angle iron in the shape of an arch over the boiler to be tested, and resting on the frame, as shown in cuts.







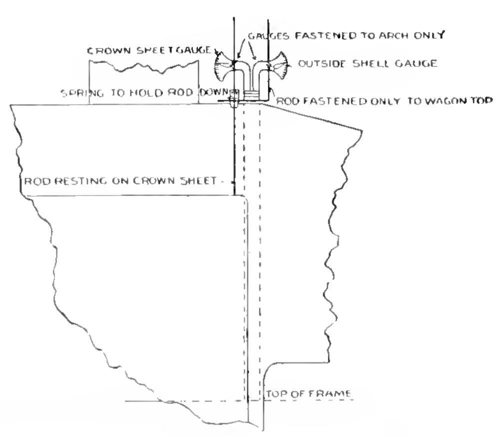


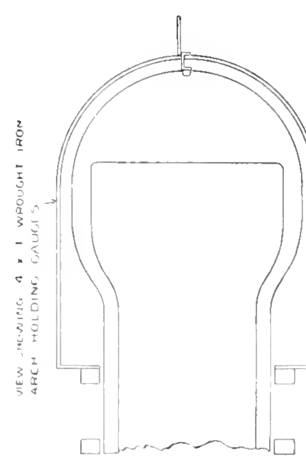
A nicely adjusted stuffing box was screwed into the top of the boiler just over the front of the crown sheet, and a steel rod put through it resting on the crown sheet; above the packing was a spring to keep this rod pressed firmly against the sheet.

The top of the rod was made to actuate an indicator on a graduated scale, also shown, and located on the independent frame.

Another similar recording device was connected to the top sheet of the boiler shell, as shown to the right.

When the boilers were fired up, a small stream of cold water was used on this iron frame, to be sure it did not expand from heat of the boiler.





Class of boiler	C.	B.	A^a.	A^b.
Time test was started	2.54 P. M.	8.10 A. M.	10.21 A. M.	2.01 P. M.
Time crown sheet moved after start	36 min.	1 min.	2 min.	15 min.
Boiler pressure at time crown sheet moved	0	0	0	0
Rise of crown sheet at 70 lbs. pressure	$\frac{1}{16}$"	$\frac{1}{8}$"	$\frac{1}{16}$"	$\frac{1}{16}$"
Total movement of crown sheet	$\frac{5}{32}$"	$\frac{3}{16}$"	$\frac{11}{64}$"	$\frac{11}{64}$"
Time outside sheet moved after start	56 min.	20 min.	15 min.	40 min.
Rise of outside sheet at 70 lbs pressure.	$\frac{1}{32}$"	$\frac{1}{8}$"	$\frac{1}{8}$"	$\frac{1}{16}$"
Total movement of outside sheet	$\frac{1}{8}$"	$\frac{11}{64}$"	$\frac{5}{32}$"	$\frac{5}{32}$"
Difference in movement of crown sheet and outside sheet	$\frac{1}{32}$"	$\frac{1}{64}$"	$\frac{1}{64}$"	$\frac{1}{64}$"
Boiler pressure at finish	130 lbs.	140 lbs	150 lbs.	150 lbs.
Type of boiler	Radial stay straight.	Crown bar straight.	Crown bar Wagon top.	Crown bar Wagon top.
Expansion of boilers, cross-section	$\frac{1}{16}$"	$\frac{1}{16}$	$\frac{3}{16}$"	$\frac{1}{16}$"

Several tests were made and records kept, the results being condensed by Mr. Boon into the above table.

⁂

There is a good-sized order for locomotives for Russia floating around New York; prices have been asked from several builders.

Shell Steel Should Be as Good as Firebox.

BY S. M. VAUCLAIN.*

I have been asked to express my views in regard to the specification for boiler and firebox steel adopted at last year's convention of the American Railway Master Mechanics' Association.

I think it is the duty of our association to further provide for the protection of lives and property entrusted to our care, by changing the specification as adopted to include under one head all steels used for boiler or fireboxes. As our specification stands at the present time, ordinary tank steel can be so presented to the consumer, and be made to fill requirements now prescribed for boiler or shell steel, whereas that for fireboxes must be of good quality. The outer shell of a locomotive boiler is subject to more severe strains and conditions than the furnace or firebox, and for that reason I stated at the last convention that I preferred personally a better steel, if possible, for outside shells than for the fireboxes. We want the firebox steel to be just as good as it can be made, and we don't want the steel for the boiler shell to be a particle inferior to it.

At the Baldwin Locomotive Works we have incorporated all that is best in the present Master Mechanics' standard specification, as adopted last year, but in addition thereto we have included the steel for the boiler shell under practically the same chemical specification as was adopted for firebox steel, with the exception that the phosphorus was permitted to not exceed point .05.

You need not be afraid that you will get this class of material too good. At the Baldwin Locomotive Works we are testing, both physically and chemically, almost every sheet of boiler and firebox steel, and are keeping a careful record of the results, and the location of the plates in the boilers, for future reference. Mr. Forsyth, of the C., B. & Q., and Mr. Gibbs, of the C., M. & St. P., are familiar with what is being done in this direction at our establishment, and of the amount of work necessary to properly do it; but, laborious as this may be, we, as builders of locomotives at the Baldwin Locomotive Works, of which I am superintendent, feel that too much cannot be done to get the very best boiler material possible.

With the assistance of the association much can be accomplished. The association standard should be high, and if the various companies, builders and so on do not want to keep up with the procession, you certainly cannot be to blame. It is better that this association should err upon the safe side, and not permit the door to be left open for inferior material to be sold and used for the construction of steam boilers of a high grade, simply because it comes within the Master Mechanics' specification.

Permit me to suggest that a chemical specification for boiler shell steel is an absolute necessity. They have adopted a first-class chemical specification for firebox steel, and it is suggested that they wipe

* Superintendent Baldwin Locomotive Works, Philadelphia, Pa.

out of existence the portion of our present specification for steel, as last adopted, relating to that for the boiler shell entirely, and hereafter require that for *all boiler* and firebox steel the chemical specification adopted last year is prescribed.

One grade of steel for boilers, and that of the very best; and, from my experience with thousands of tons of this material, the best need not necessarily be the highest-priced. You cannot make the chemical specification too rigid for me.

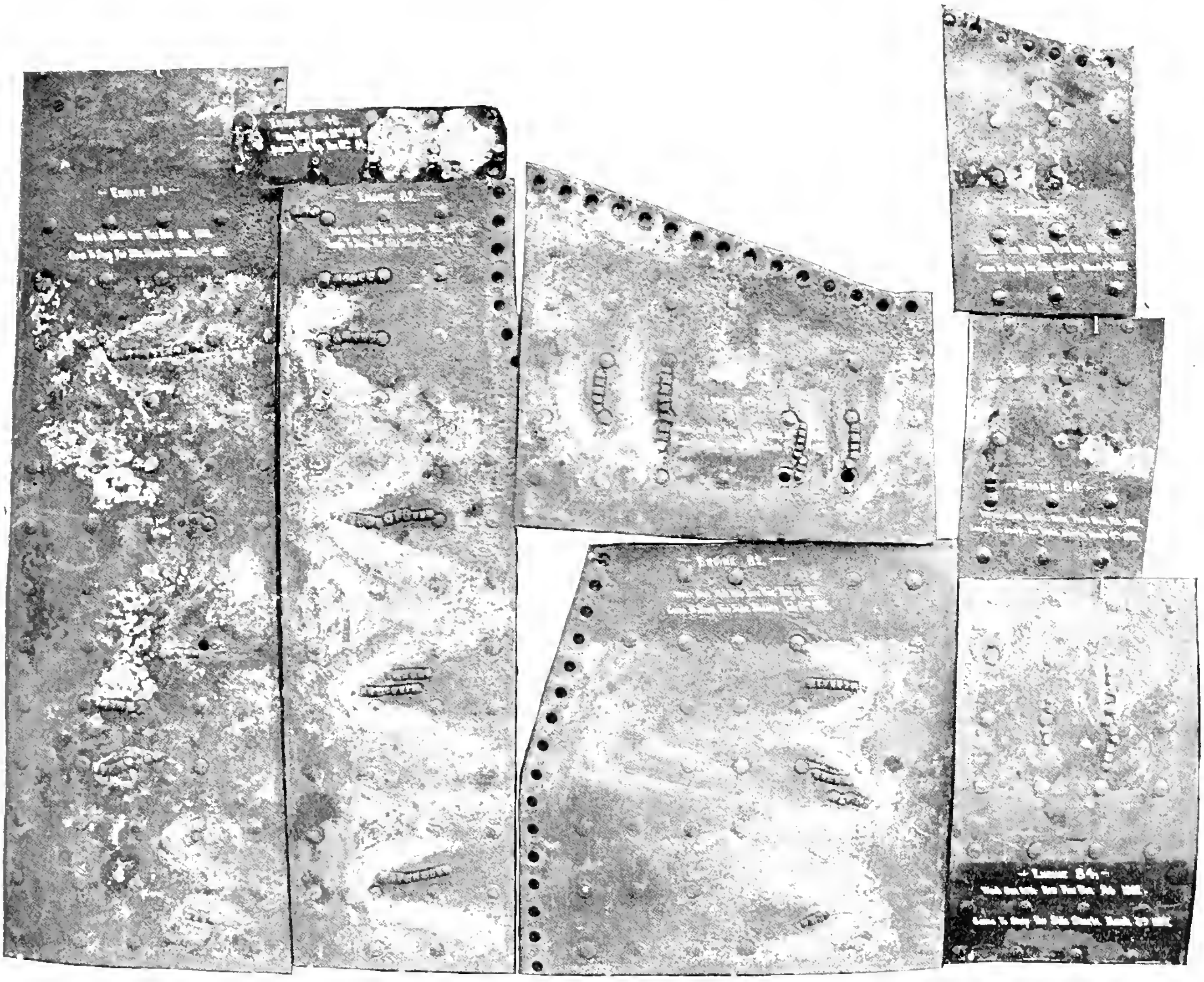
This improvement of specifications ought certainly to receive the attention of the association at the next convention.

box. This engine had a new firebox on May 19, 1892, and came in for new side sheets February 5, 1895. The very small sheet, marked "Engine 40," is of still another make. There is quite a wide range in quality in these sheets.

In a personal letter on the subject, Mr. Samuel F. Prince, Jr., superintendent of motive power and equipment, says:

* * * "You ask me if I have any theory as to the cause of this cracking, and I say to you frankly that I have not. If you will note, most of these cracks are in the interior of the plates, and not at the edge, consequently are at points where

ing due to the rolls, or, in other words, to the density. It is claimed that the annealing of the individual plates that go to make up a firebox, after they have been subjected to all necessary mechanical manipulation, obviates all the troubles that firebox plate is heir to. I am just a little skeptical in regard to this, as, from my own knowledge, I know that plates so annealed have given trouble by cracking. My own idea in regard to annealing is this: That the entire firebox, after it has been riveted up and calked, should, as a whole, be thoroughly annealed; this discounts any local disturbance due to mechanical manipulation, and would simply necessitate a light calking all around to meet any opening of edges



Some Firebox Sheets That Cracked, Long Island Railroad.

Some Firebox Sheets That Failed.

Our engraving was made from a photograph taken at the Long Island Railroad shops, of some firebox sheets that had to be taken out on account of cracking.

The long sheet to the extreme left and the three smaller sheets on the right are one make of steel, and came out of the same firebox.

This engine went out of the shop with a new firebox in February, 1892, and came in for side sheets March 4, 1895.

The three large sheets in the center are of another make, and from the one fire-

there has been little local disturbance, outside of punching holes for stay-bolts, touching same. I would state that none of these plates were annealed after the local manipulation necessary to prepare them for position in firebox; consequently the local treatment due to scarfing, etc., would not materially affect the interior area of the plates. These plates were all sent to one of the manufacturers of firebox plates in this country, for chemical and physical analyses, and perhaps those analyses may show up a lack of uniformity in the chemical and physical composition, and likewise in the density of the plate. In rolling large plates, the plates are more dense at the edge and less so in the middle, and it may be possible that this cracking is due somewhat to that variation in work-

of plates due to the annealing. Of course, this would require special annealing furnaces; but you thus have your pudding all cooked at one time in the same oven, and not cooked in sections by several different cooks.

"I am waiting with much interest the result of the analyses of these various plates of which you have photographs, and after seeing same may be enabled to arrive at the real cause for cracking.

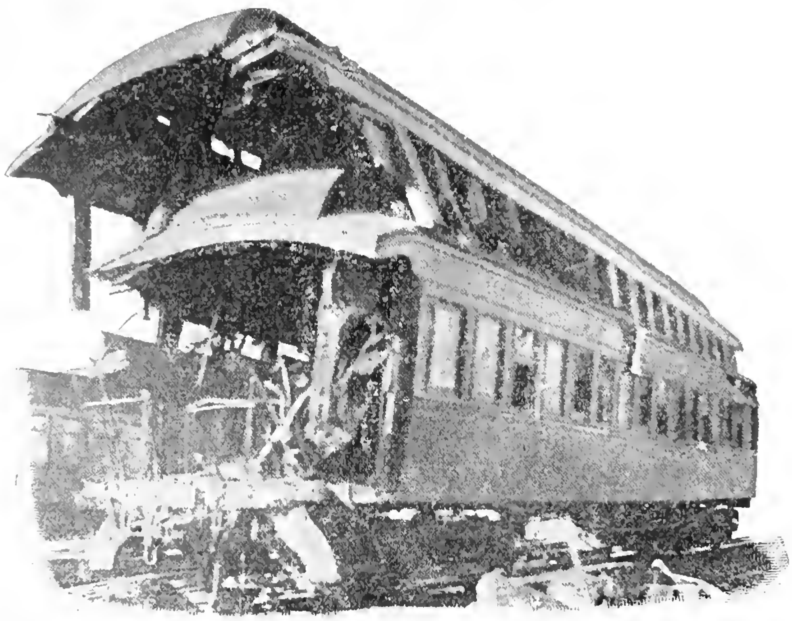
"You speak in your letter of the fact that expensive steel firebox plates are found cracked along with those of a cheaper grade, and while this is so, the percentage of cracked expensive plates to that of the cheaper grades is very small." * * *

CAR DEPARTMENT.

Conducted by Orville H. Reynolds, M. E

A Freaky Wreck.

One of the queerest freaks in telescoping that ever came to our notice, was caught by the camera just after towing in from the wreck, occasioned by the collision of a freight and passenger train. The picture shows two coaches exactly as they were found after the shock ; the one on top was ment was the fact that the forward car shot from its trucks with just enough energy to plow through the car behind and stop with the ends of the two cars directly in line. The fellow who answers the "What did I do" puzzles can have a chance to explain some of the peculiarities of this wreck.



forward of the lower one when in the train.

It is hard to conceive a force of the intensity that could accomplish such utter ruin, and still leave the outlines of the upper car, which is sheared the whole length at the belt rails on both sides, and wiped off the records completely. The floor is gone, but the truss planks are there, showing plainly—one up under the hood and the other about half way down at the left side. There was not much damage to the lower car, aside from the ends being out and the seats destroyed. Although the upper car plowed through the inside of the lower, the posts of the latter were not started at sills or plates, and were not touched in course of repairs. The trucks were not disturbed or injured. One of the strangest freaks of this wreck was the fact that not one of the lamps in the lower car were touched ; even the shades were in their places, and without a crack.

Another thing that caused lots of com-

Freight-Car Design.

The want of uniformity in size of freight cars of like capacity—and this refers not to dimensions of details so much as to length, height and width of body—would appear to furnish an excellent pretext for some committee work in the conventions, where the touch of the master-hand has so often made rough places smooth when standards were under discussion.

This state of things was not so glaringly in evidence in the 40,000-pound equipment, for the reason that the limit was reached and passed in a 33-foot car, and all were content to build on general similar lines. But what a transformation when the demand for a 60,000-pound car began to press itself ! All the railroad Aladdins brought out their rusty lamps, and each rub produced a genie with a car of the required capacity, whether for oats or ore. These slaves of the lamp have visited on us an evil that will be felt down several generations, even if a halt is called by those in a position to enforce it.

That caprice is still a condition and not a theory in the matter of car design, we have all needed proof in the diversity of sizes shown in cars of same nominal capacity. A range in length from 34 to 38 feet, with widths and heights showing the same easy disregard for the fitness of things, can often be ascribed to no other cause than somebody's itching to stand alone in this particular field, to furnish the mechanical world an opportunity to admire the transcendent genius that can give us a car unlike anything going before.

It is not the practical man who lays himself open to criticism—not he. "Fools walk where angels dare not tread," and always give us results proportional to the recklessness and pull of the sprinter. This will account for some of the wild creations in rolling stock that are on exhibition occasionally, and exposes the element that will silently work to defeat any approach to a standard, no matter how faithfully or zealously those lower down the official scale may work to that end.

The volume of the inside of a car should be the index of its capacity, letting that represent any number of pounds found best for the service ; this once established for average ladings of merchandise, it would be a long stride toward the goal of a standard. Since 35 feet is the average length of these large cars, 7 feet under carlines and a width of 8 feet 3 inches would give 2,000 cubic feet.

If now this volume is found sufficient for the average 60,000-pound load, it is certainly not a sound business proposition to build cars having a cubic capacity 50 per cent. in excess of its needs. There are three potent reasons for this : First, the car of greater volume has a greater area to present to the wind, thus increasing its resistance and, without its center of gravity is low, its chances for turning over ; second, a greater dead weight per unit of paying load ; and third, the greater cost.

These are valid objections to the use of a car larger than necessary to handle average loads ; they cannot be ignored if a standard is adopted based on anything like economic grounds, and no one having a proper knowledge of the situation will question the truth of the assertion that nearly all 60,000-pound cars are heavier than their capacity warrants.

A car body 35 feet long, with 2,000 cubic feet capacity, having sills and framing designed to keep down dead weight, will weigh 18,000 pounds, but the truss rods must have such a depth at the needle beams that they will carry the load, and not be merely tie rods, as too many are in fact.

The trucks to go with this car must also receive the same care in distribution of material where it is needed—thus designed on correct lines, eliminating all useless patented features, will weigh not more than 10,000 pounds. The total weight of car will then be 28,000 pounds, and as light as can be obtained by the present wooden construction, and then only by the exercise of sound judgment in providing for all strains with a factor of safety sufficient for strength and no more. Any excess of material means dead weight, and simply demonstrates that the designer don't know a bending moment when he sees it.

These figures carry a moral that it would be well to heed, when it is remembered that very few of our 60,000-pound cars weigh less than 30,000 pounds, and in some cases reaching as high as 33,000 pounds. Furniture cars, and other abnormally large special cars, are not considered in the above, for the reason that the immensity of their proportions imply weight, and those who enjoy these luxuries must expect to pay for them ; but there is no good reason why the regulation 60,000-pound car cannot be brought to the figures named, and thus pave the way to standard inside dimensions. This would have the effect of ultimately looking to uniformity in arrangement of details of framing ; and following on this, might possibly come something like uniformity in sizes of all timbers in box-car construction.

There is a healthy interest taken in this matter of a standard for 60,000-pound cars by many rolling-stock officials, who are fully alive to the advantages known to be had in such a scheme, all of which are too plain to waste good space on ; while in other cases there is a too evident disposition to put a gag on anything that savors of a standard, and this spirit will have a tendency to defer for a time the consummation of a move that should be in effect at the earliest moment.

Many tough problems in standardizing car work have been solved by the bright minds that are ever on the alert for a nut to crack, and this one will be handled without gloves if they are unfettered and not interfered with by the pretenders.

As the matter stands at present, it is only necessary to put in more truss rods, some $4\frac{1}{4}$ x 8-inch axles, and use a stencil denoting the increase of capacity, to make any of the old arks good for 60,000 pounds.

Having shown that there is a possible difference of 4,000 pounds or more in the light weight of this class of cars, a little calculation will make it plain that the heavier ones are hauled at a loss.

If it costs, say, $\frac{1}{2}$ cent per ton-mile, the books must show a balance on the wrong side, equal to: $5 \cdot 2 \times 100 = \$1.00$ for each car hauled 100 miles. A nice premium to pay for the privilege of advertising a blunder.

Let us have some reason for the statement that a car has a certain load capacity in pounds. Let it come from those who are fitted by experience to pass on this important question—from men whose names beget confidence. We shall then have something more tangible to work on than is now found in car literature.

Improvements on European Cars.

Within the last five years there has been more real progress in the improvement of cars on European railways than there was in the previous sixty years of railway operating. It is undeniable that the American car, with its conveniences for intercommunication, has been the model on which European improvements have been based. Till recently they have adhered tenaciously to the compartment car, which could not by any means be made safe and comfortable for railway travel. It had time-honored attractions, and that maintained it in use when every argument of safety and convenience was against it. Government bureaus wrestled with railway companies to compel them to provide means by which passengers in the isolated compartments could communicate with the train hands when robbers, murderers and violators were assaulting them, but no ingenuity could overcome the inherent weakness of the secluded section. However desirous a railroad company might be to provide means of protection to the passengers, the secluded nature of the small apartment made their efforts futile.

The old European car is a triumph of development in an unbroken line from the most elementary forms. The most primitive form of carriage was two parallel rails connected with a seat in the middle for the burden. A man at each end carried the load. This was called a hand-barrow. A more pretentious form of the hand-barrow was the sedan chair of Europe and the palanquin of India and China.

The first radical improvement on the hand-barrow was putting a wheel at one end, when it became a wheel-barrow. The miners in Europe who were forced by necessity to invent means for transporting coal and ore cheaply, increased the size of the barrow, put two wheels at each end and a big box in the middle, which made the car. When this was put upon railways, the rails were used as bumpers for contact with connecting cars. They called it a wagon. This is the European freight car of to-day, but every year it is becoming heavier.

When European engineers wanted a passenger car for railways, they took the stage coach for their model and placed it on the pair of parallel rails. As the solid ends of the rails made too great a shock when loosely-coupled cars bumped together, spring buffers were invented. The coupling of all European cars is in the middle ; and a radical improvement suggested by the uncomfortable concussions of loose couplers, was a screw coupling, which binds the cars tightly together. The line of improvement followed on European cars until lately, has been merely to enlarge the old designs. Within the last few years, however, radical changes have been introduced, thanks to the preaching of the engineering press. The corridor car is becoming common on all lines. This is a vestibule car, with side passages which permit the passengers to pass from car to car. With minor modifications, it is the American car.

To Strengthen Passenger-Car Ends.

There appears to be considerable effort going on among railroad car builders to strengthen the ends of passenger cars and make them stronger to resist the shocks of accident. A note which we publish on the subject lately elicited inquiries from the mechanical departments of several railroads, all of them being anxious to know what roads were working out special methods for strengthening this part which is the weakest feature of our passenger equipment.

The committee appointed last year by the M. C. B. Association to investigate the subject of Passenger-Car Ends, reported that the National Government has lately required that the ends and frames of postal cars used by the railroads to transport the United States mails shall be strengthened and provided with vestibules, and it has issued instructions describing to some extent how this shall be done. Some of the railroad companies are now constructing cars in which they have endeavored to meet these requirements, and others are debating the advisability of entirely doing away with the platform on all kinds of passenger-train equipment cars that do not require accommodations at their ends for the entrance and exit of passengers, or at least of making only a very small one on them by extending the main floor framing a short distance beyond the end of the car body. Many improvements are being worked out in other directions also. Iron or steel of various forms are finding a place in the framing at the ends of passenger cars; the fastening of the usual platform to the car body, and the attachment of the coupler, are both undergoing changes in recent practice, with a view of giving greater strength to the one and more flexibility to the other ; different forms of vestibules are also being tried. And none of these plans has yet advanced entirely beyond the experimental stages.

Further, the large individual car builders and coupler manufacturers are actively engaged in developing their ideas in the same direction, and thus there are features

the association would have to avoid as well as those it must prove by actual test.

To those interested in this subject we would commend the practice of the Lake Shore & Michigan Southern, and of the Michigan Central. Both of these roads have for several years been devoting most intelligent attention to the strengthening of passenger-car ends.

Grab Irons, Grab Irons, Grab Irons.

On a recent trip through the country between New York and Buffalo, the writer found every shop busy making grab irons, and car repairers hustling them on. Everybody seems to have remembered the standard-height law, but to have forgotten all about the law requiring grab irons on each side of each end of all freight cars.

Some are using the uncoupling rod of the M. C. B. coupler as a grab iron for one side, and it answers nicely if there is room to get the fingers under it. In some cases room is made by cutting out the wood.

Those who have bolt headers are upsetting the ends of rods in them, flattening the head under the hammer, and punching the hole. Most of the shops bend the end over and flatten that down.

Car shops are making grab irons by the car-load; one company stated that they had orders for all they could make until September.

More grab irons were put on in the first two weeks in July than in five years before, and if matters had been allowed to remain as they were, all the cars would have had grab irons within a month or so; but a petition was gotten up for an extension of time, and on July 15th the Interstate Commerce Commission extended the time within which the law of 1893, providing for the safety of employés on freight cars used in Interstate traffic, shall go into effect. The ruling of the Commission is that the time within which handholds shall be put upon cars shall be extended to December 1, 1895, and the time within which all drawbars shall be changed to a uniform height shall be extended to February 15, 1896.

The work of raising cars to the standard height is going on all right, and the rolling stock will be in good shape in this connection before long.

The extension of time on handholds will check the work of putting them on, and we doubt if there will be as many cars equipped on December 1st, under the extension, as there would be if the extension had not been granted. The way to resume is to resume, and the way to get handholds on cars is to get them on. With every shop in the country making handholds and hunting for cars to put them on, it wouldn't have taken another two weeks to have gotten the job done.

Meanwhile the heads of the mechanical departments of the leading railroads running into Chicago, at a meeting held July 16th adopted a resolution, that when the law goes into effect February 15th, 1896, cars in service shall be marked "Bad Order" if the drawbar measures less than $31\frac{1}{2}$ inches empty or loaded, or higher than $34\frac{1}{2}$ inches empty or loaded.

The chances are that other leading railroads will adopt the same policy towards cars that do not comply with the law.

We learn that the handsome walkover car seats, which were exhibited at the recent conventions at Thousand Islands, have been ordered for the twenty handsome coaches which the Pullman Company are building for the Southern Railway, as well as the coaches building at the same works for the Boston & Albany road. The Big Four, the Plant System and Cleveland, Lorain & Wheeling R.R. have also ordered a number of them. Since the inventors (Hale & Kilburn) placed this practical and luxurious seat on the market it has scored a complete "walk-over."

The Standard Coupler Company having, a year and a half ago, purchased all the patents, property, etc., of the Standard Car Coupling Company, and assumed the contracts of the same, the latter company was, during the past month, granted an order in the New York Supreme Court, winding up its affairs. To avoid any misapprehension in the matter, the Court in its order says: "This order does not relate to, and shall in no way affect the Standard Coupler Company, organized and doing business under that name in the city of New York and elsewhere, which corporation is entirely independent of and distinct from the corporation herein sought to be dissolved."

The Fitchburg Railroad people are putting the M. C. B. coupler and air brakes on at least twenty freight cars every week. Mr. Marden, superintendent of the car department, has arranged a variety of labor-saving devices and methods which materially reduce the cost of doing this work. When a car is taken in to have air brakes and couplers put on, it is thoroughly inspected, and if any sills or other parts are found in bad order they are removed. By this means the company is systematically rebuilding all the cars in need of repairs.

The Wm. D. Gibson Company, Nos. 12 and 14 So. Jefferson street, Chicago, have a quarter-page advertisement this month showing some of their styles of springs. They manufacture special springs for all purposes to order, including car seat, air brake, trolley, coupler, engine and valve springs.

The Great Northern and the Missouri, Kansas & Texas have specified the New York air brake for their new rolling stock.

Some Information About Rubber Hose.

Some interesting cuts are shown in this issue in the advertisement of the Peerless Rubber Mfg. Co.

Those who know all the ins and outs of the rubber hose business can give users some valuable pointers. In speaking on this subject, Mr. C. H. Dale, general manager of the company, said:

"The use of wire in wrapping hose is to be deplored, particularly if steam is employed, from the fact that hose when conducting steam softens at least 25 per cent., and it also has a tendency to expand the hose. It is a well-known fact that couplers require an exact length of hose on many of the roads, and the complaint is that the hose *grows* too short, which is owing to the expansion of the hose. Many of the manufacturers and railroad companies have decided to overcome this expansion by wrapping hose with wire. The result is that while the hose does not expand much and contract in length, it must move somewhere, so it goes in the only direction which is left. In other words, it swells the inside of the tube, eventually choking up the inside diameter of the hose completely.

"Some of the air-brake coupling castings sold have burrs on them, on the shank of the coupling. A small burr will cut the tube of the hose very readily, and the tube of any hose once punctured, its usefulness is gone.

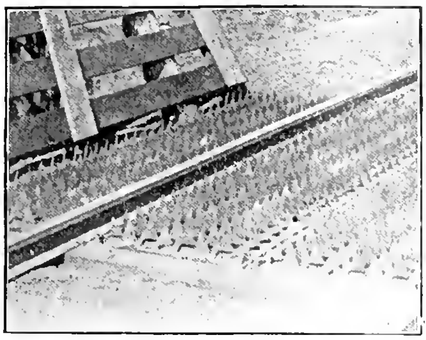
"The duck in hose simply indicates the hydraulic strength, and the better the tube, coating and friction, the longer the life of the hose; that is, it will stand the mechanical motion better if made of good material instead of cheap. The cheaper grade of hose grows hard and will crack in a very short time, while the better gum or rubber will wear for years without getting hard. Too much dependence is placed by the average buyer on the hydraulic strength of hose. Beyond a certain point it is not important.

"The cheaper a buyer demands rubber goods, the less rubber he naturally gets. All mechanical rubber goods are compounded with minerals, and minerals are cheap. The most expensive thing in hose is the rubber, next comes the duck. It is a well-known fact that the rubber in its green state, being ground and compounded, will absorb or mix with a very large amount of minerals. It will absorb as high as 80 per cent., but any rubber compounded to that extent has no life in mechanical service. It will not stand mechanical motion, owing to there being very little substance or body to it. The better grades contain from 20 per cent. to 40 per cent. of minerals only."

The Fitchburg people are about to put air compressors in all their principal car and locomotive shops. Mr. Marden, superintendent of the car department, is getting out designs for an air hoist powerful enough to lift cars.

A "Horse Sense" Cattle Guard.

Our little engraving shows the construction of a new form of cattle guard made by the Sheffield Velocipede & Car Co., of Three Rivers, Mich. This guard is composed of four strips (duplicates) of boiler steel, in which sharp teeth are struck up close together. This simply requires spiking to



the ties; has no rods, rivets, bolts or loose parts to wear and make a noise; presents a surface little likely to collect dirt and snow, and one on which a hoofed animal cannot walk. Surface guards have saved lots of money formerly wasted in building and keeping clear pits, and this seems to be a good one of the kind. The sheets are furnished either coated with pure asphaltum or galvanized.

Too Complicated for an American.

During a discussion on compound locomotives at the last Master Mechanics' Convention, a speaker who had been in France a short time ago remarked:

"The compounds to be seen in France remind me of an incident that happened in the West years ago. The Denver & Rio Grande people had a Fairlie locomotive, a double-headed machine, like two engines coupled together. She was a very inconvenient, complicated machine, and none of the men liked to run her. There was an Englishman on the road who had been accustomed to locomotive monstrosities, and he was put running the Fairlie as pusher on a grade. He got on to the time of another train one day, and the order was given that he should be laid off for twenty days, and a man was sent to relieve him. The man that was sent to relieve him had never had anything to do with that Fairlie engine. He looked her over very carefully. He looked at what this was for, and how that was intended to work, and where were the different points to be reached for oil, and what all the levers and cranks and handles and contraptions were for. The man who was to be laid off explained it all very patiently to the other fellow for about half an hour, and after it was thoroughly explained the man who was sent to relieve the other said: 'Well, friend, you keep on running the engine and I will take the twenty days.'"

WHAT YOU WANT TO KNOW.

Questions and Answers.

(103) M. H. N., Haverhill, Mass., writes:

Why will an engine cut off her exhaust quicker and sharper in the back than in the forward motion? *A.*—There is no difference.

(104) F. C., Bloomington, Ill., asks:

If setting the reverse lever and the rocker plumb is the proper way to get the length of the reach rod? *A.*—We think plumbing the reverse lever and the tumbling shaft the better way.

(105) A. S., Covington, Ky., asks:

1. Which is the proper position to set up the side rods of a locomotive? *A.*—Some rod men prefer one point, others another. We prefer the dead center. 2. Is it not best to put up the rods when the engine is hot? *A.*—Yes.

(106) J. H. H., Burbank, Cal., writes:

Progressive examinations say that a man should begin firing when he is eighteen years old, others say he should begin earlier. Who is right? *A.*—Eighteen is young enough for the hard work to be done. On some roads firemen are not hired until they are 21 years old.

(107) W. O., Dayton, O., writes:

If the center line of cylinder was placed 9 inches above the center line of the main driving axle, would it make any difference in the working of the engine? *A.*—The power transmitted through the main rod would be operated through an angle which would materially increase the friction, and it would increase the inequality of steam distribution due to the angularity of the main rod.

(108) W. L. C., Crewe, Va., writes:

Can Mushet steel be welded? If so, describe the process. *A.*—B. M. Jones & Co., of Boston, who handle the steel in this country, replying to an inquiry, say: "Mushet steel can be welded. It has been brazed, and it has been pressed in a machine, borax being used in both cases, and the result has been satisfactory. We cannot, however, consider it in the light of a commercial success, because it depends so entirely upon the individual skill of the workman."

(109) A. S. H., Islington, New South Wales, writes:

1. Are the snifting valves on the steam chests of American locomotives supposed to relieve the valves with steam shut off? *A.*—Yes. 2. If so, what is the saving when the extra cost of fuel consumed is taken into account? *A.*—We doubt if there is any saving. 3. Is it not a fact that air is drawn in through these valves that cools the cylinders and causes extra condensation? *A.*—We believe this is likely the case.

(110) F. C. F. E., Charlestown, Mass., writes:

When we have a main connection that runs hot with oil in the cup, we put common hard soap in the strap and then put on the cup. The connection runs cool as long as the soap lasts. What I want to know is, does the soap take the temper out of the steel of the pin or not? One master mechanic claims it does, others that it does not. Which is right? *A.*—We do not believe that soap will take the temper out of steel any more than tallow will, but a crank pin is not tempered.

(111) J. G., Jackson, Tenn., asks:

1. How far will the steam follow the piston in a 24-inch stroke engine in full gear? *A.*—About 21 inches. The exact point of cut-off depends upon the lap of valve and arrangement of valve gear. 2. What is in the ashes and clinkers that eats up the iron and ties? *A.*—Probably elements that turn into sulphuric acid when exposed to air and moisture. 3. Does the Crane air brake work on the principle of the Westinghouse air brake? *A.*—Yes. 4. Do the engines of large steamships use steam expansively? *A.*—Yes. 5. Did the electric headlight prove a success? *A.*—Yes. 6. Does the Manhattan Elevated Railroad use the Westinghouse air brake? *A.*—No; the vacuum brake is used there.

(112) G. S., Edgemont, O., writes:

Can a railroad company collect a bill from a foreign road for putting in a pair of wheels to replace others having sharp flanges or worn tread, if defect card was not given when car was received from connecting road? For instance, the flange might not be worn down to gage when received, and in two or three days be below gage. *A.*—The owner of the car is responsible for the cost of wheels removed for sharp flanges or worn tread. 2. If any breakage takes place on a car in ordinary service, whether from defect or not, can the owner collect for cost of repairs? *A.*—Yes; unless it be for a part for which owners are held responsible, particulars of which are given in the Rules of Interchange of Cars.

(113) Subscriber, Little Rock, Ark., writes:

1. Will you inform me how to find the off-set in a link saddle? *A.*—The point for the center of the saddle pin is found by laying the motion down on a drawing board and finding by measurement the point which will best adjust the cut-off. It is often found by clamping a temporary saddle on the link and trying various positions. 2. Why is an off-set put in a rocker, and how is its extent found? *A.*—An off-set in the rocker is necessary when the axis of the cylinder and the center line of motion do not coincide. To give an intelligible direction of how to find the extent of off-set would take too much space for these columns. It is explained in all good books that treat on link motion.

(114) W. E. F., Charlottesville, Va., writes:

1. I am running a 19 x 24-inch eight-wheel engine. When I open the throttle and pull the reverse lever to a short cut-off at high speed, there is a tremendous kicking on the left side. It can be remedied to some extent by partly closing the throttle and advancing the reverse lever. What is the cause? *A.*—We should say that the engine had too much compression, but why the kicking should be only on the left side we cannot understand. 2. Is not inside lap a disadvantage to an express engine? *A.*—We have always found that it caused too much compression in a fast-running engine, but the valve motion might be so designed that the inside lap was all right. 3. What size nozzle should a 19 x 24-inch engine use? *A.*—That would depend so much upon the kind of coal used that we could not answer definitely. About $3\frac{1}{2}$-inch double and 5-inch single is a fair average. 4. Would a small nozzle have any effect upon an engine's adhesive power? *A.*—If you mean its tendency to move without slipping, it would not; if you mean tractive power or hauling capacity, it would be reduced by a small nozzle. 5. In case of a broken eccentric strap, would it be safe to disconnect the link lifter and allow the other strap to remain on? *A.*—This is a question that there is a difference of opinion on among good judges. Our advice is,

take down both straps. 6. When I sound my whistle on a damp morning, I notice sparks fly from the whistle rigging. Are they electric sparks? If so, how are they generated? *A.*—They are no doubt electric sparks, generated by the friction in some way. We cannot say how the electricity is generated in that particular case, but slight shocks are felt on many locomotives.

Theodore Alteneder & Sons, the well-known manufacturers of the Alteneder drawing instruments, boxwood scales, protractors, etc., are out with a new catalogue containing much useful information for engineers and draughtsmen. A copy will be sent to any of the readers of LOCOMOTIVE ENGINEERING free, on receipt of 4 cents in stamps to pay postage.

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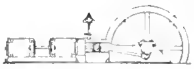

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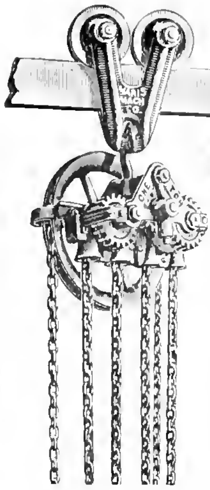

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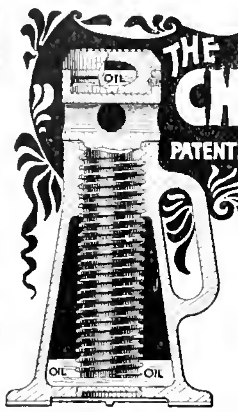

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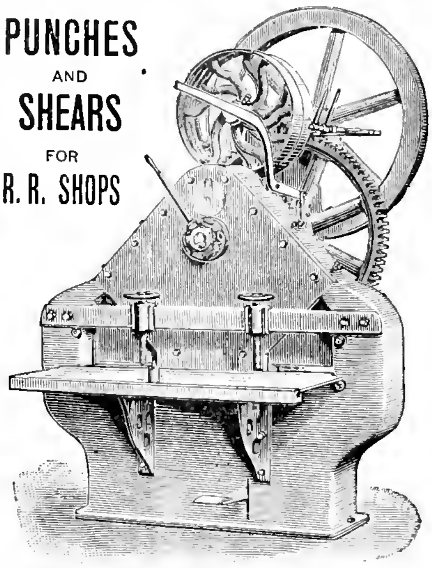

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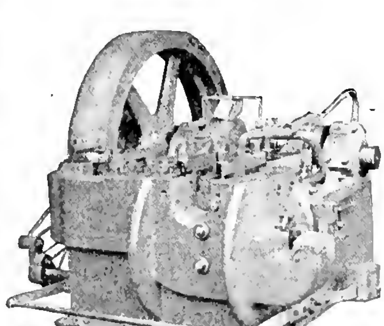

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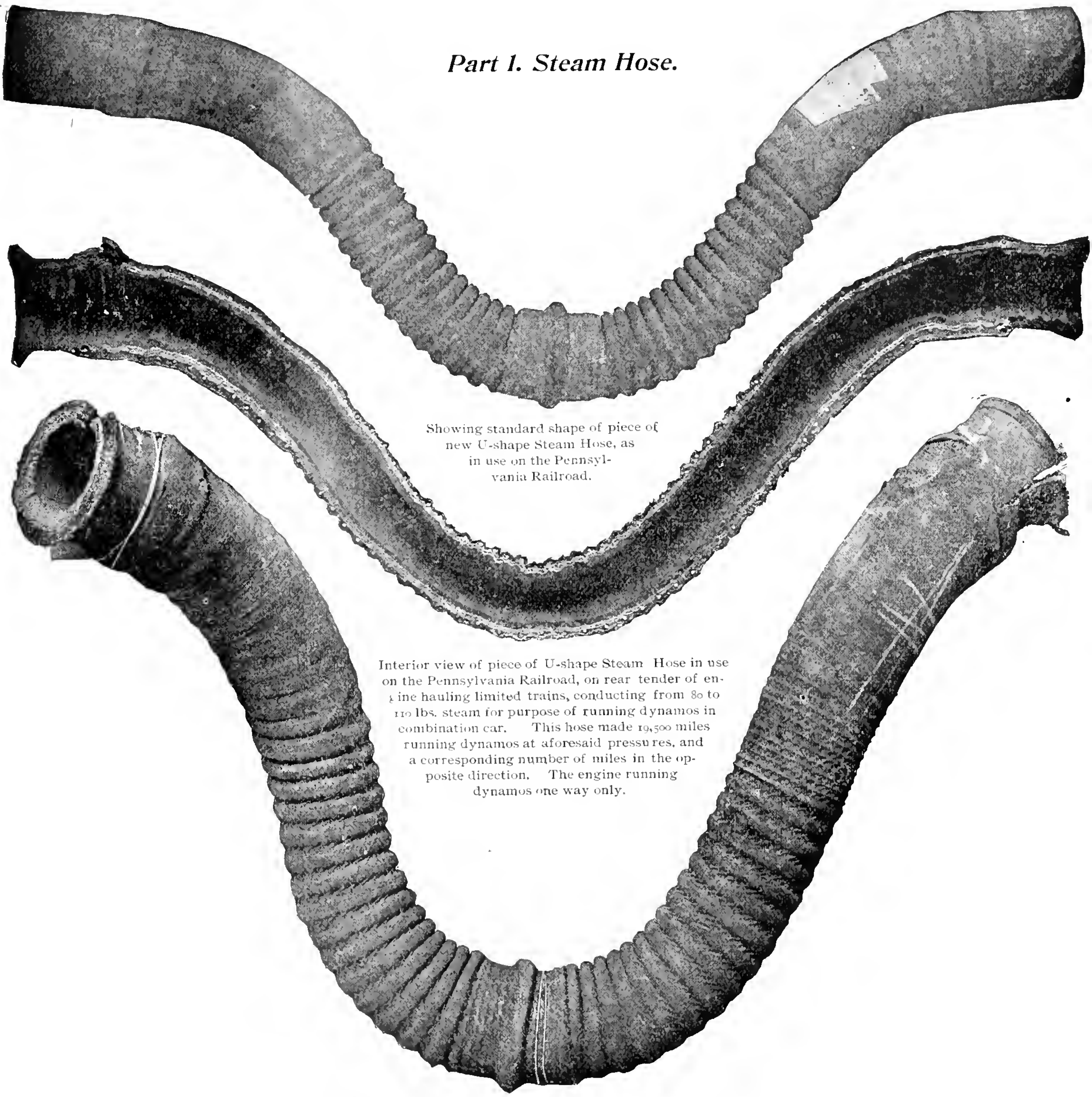
Part I. Steam Hose.



Showing standard shape of piece of new U-shape Steam Hose, as in use on the Pennsylvania Railroad.

Interior view of piece of U-shape Steam Hose in use on the Pennsylvania Railroad, on rear tender of engine hauling limited trains, conducting from 80 to 110 lbs. steam for purpose of running dynamos in combination car. This hose made 19,500 miles running dynamos at aforesaid pressures, and a corresponding number of miles in the opposite direction. The engine running dynamos one way only.

Showing a piece of Peerless U-shape Steam Hose in use on the Pennsylvania Railroad for two seasons. Still in good condition.

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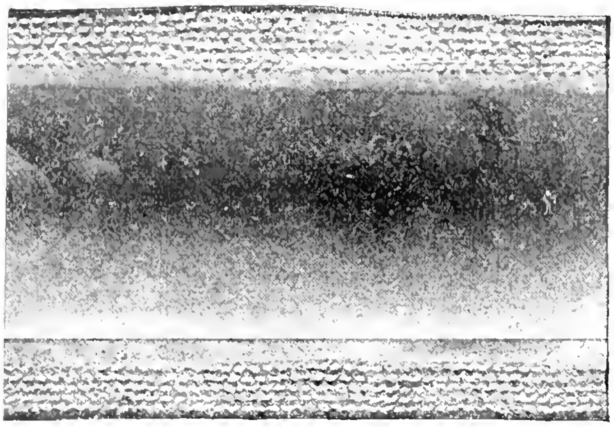
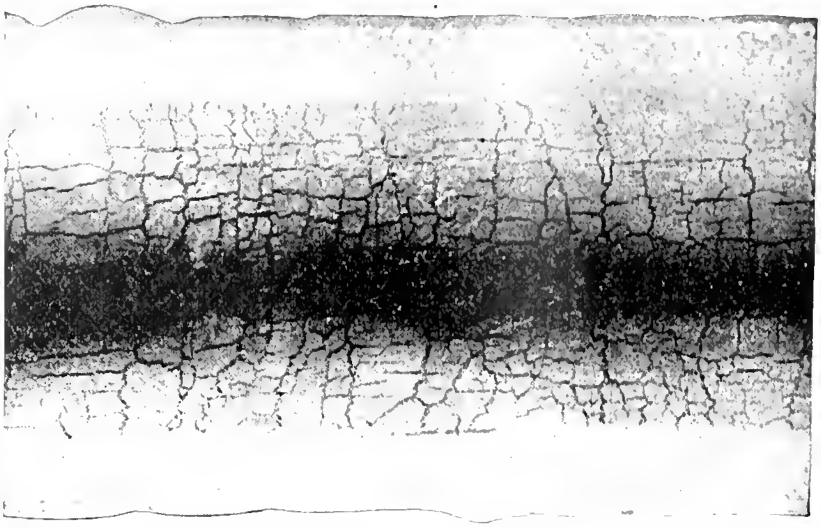
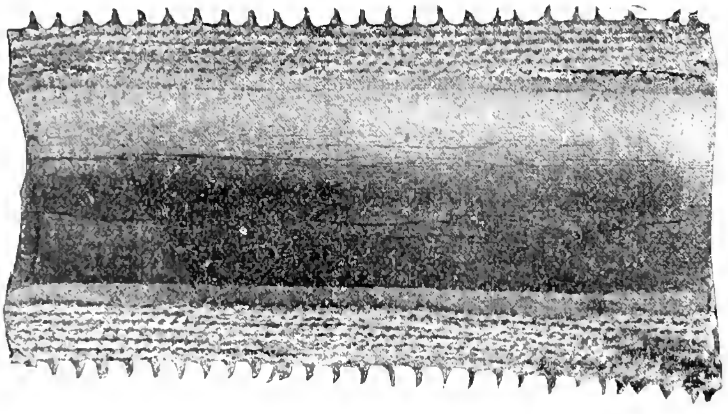


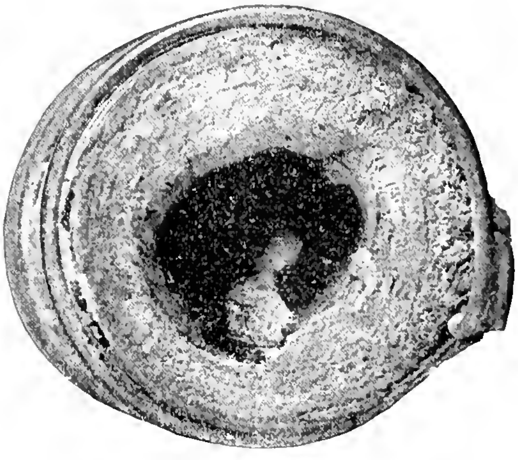
Interior view of new Peerless Steam Hose, before use.



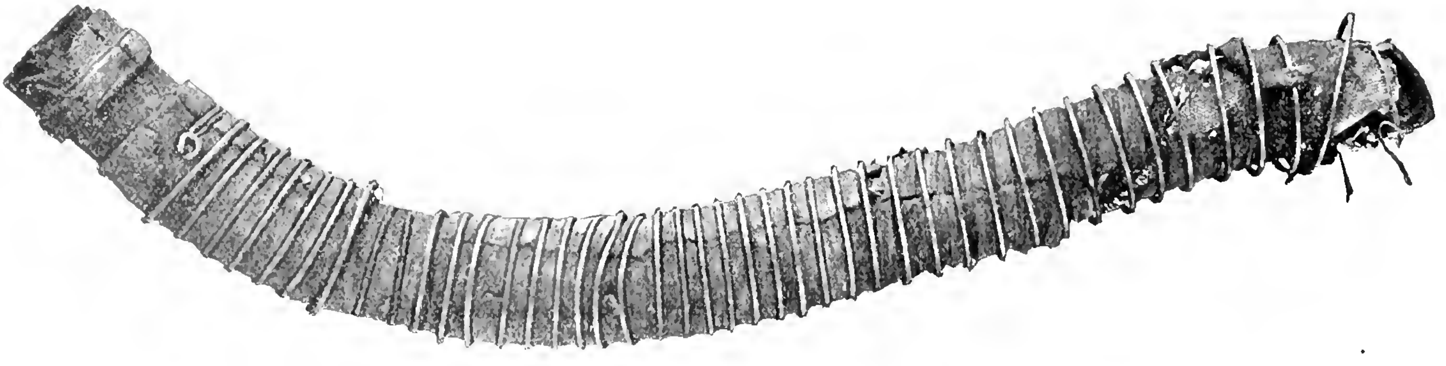
Interior view of section of Peerless Steam Hose in use on N. Y., O. & W. R. R. for three seasons, carrying from 35 to 60 lbs. steam. Still in fairly good condition.



Interior view of Peerless Steam Hose used in electric light plants. In use for six months blowing off steam from 120 to 160 lbs.



End view of hose made by competing company, wire-wrapped, showing inside diameter decreased to one-half its normal size. Cause cheap material, and wire wrapping contracting it and not allowing it to expand.



Exterior view of wire-wrapped hose made by a competing company; was on rear of tender of engine. Shows the hose badly burned and bursted. Principal cause wire wrapping and cheap material.

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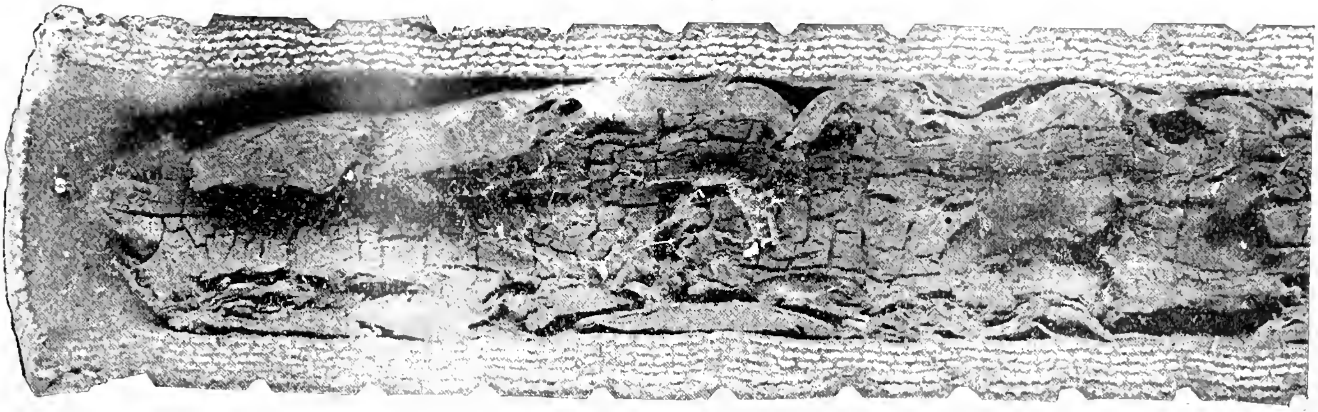
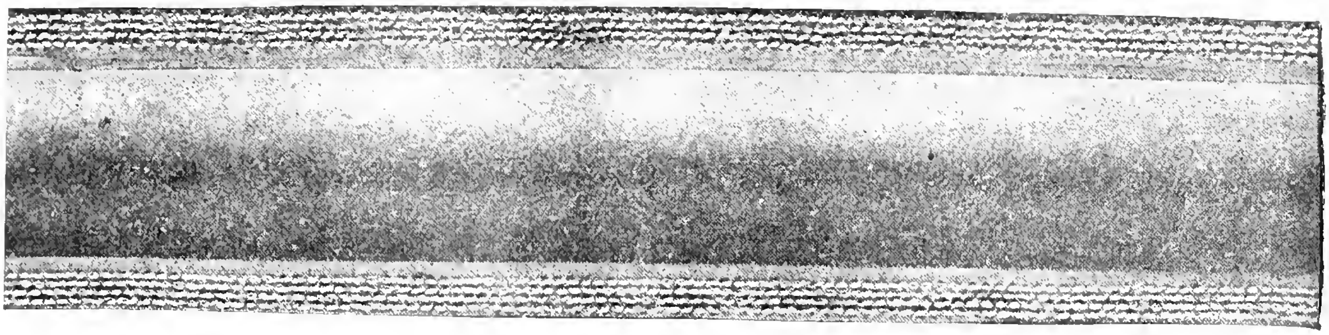


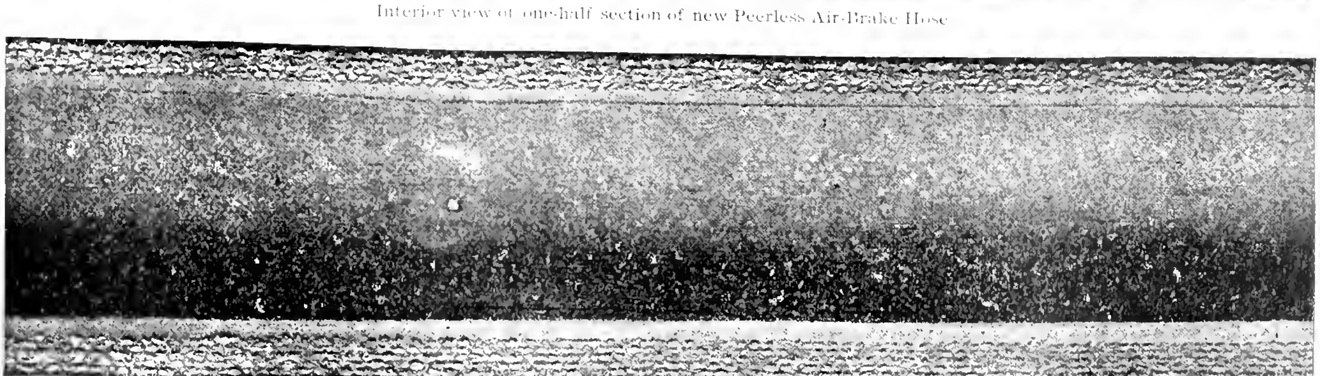
Interior view of competitor's hose, showing disintegration caused by the use of cheap material and wire wrapping. Hose in use only part of season.

Part 2. Air-Brake Hose.

Exterior view of new Peerless Air-Brake Hose, $1\frac{1}{4}$ inches diameter, showing Peerless label.



Interior view of one-half section of new Peerless Air-Brake Hose



Interior view one-half section Peerless Air Brake Hose, in service on N. Y., O. & W. R. R. for over three years. This hose is guaranteed in passenger service for three years.

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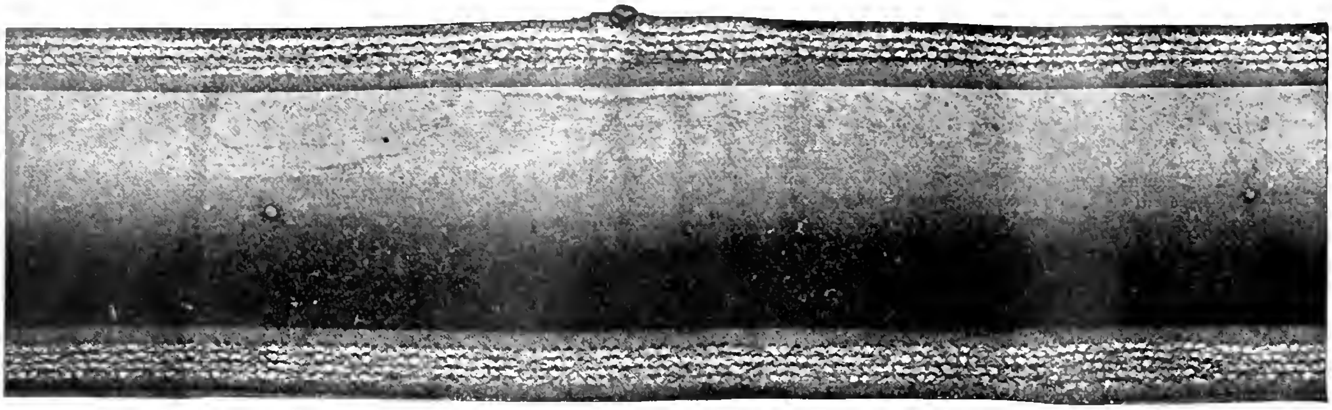
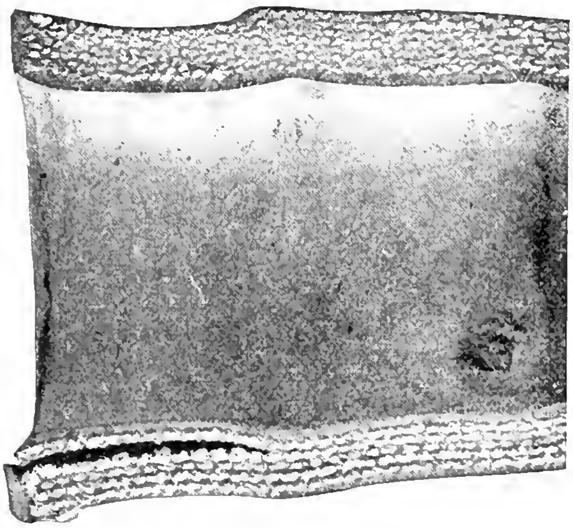
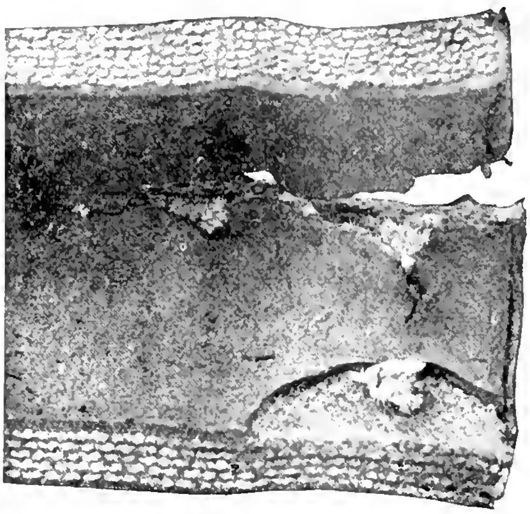
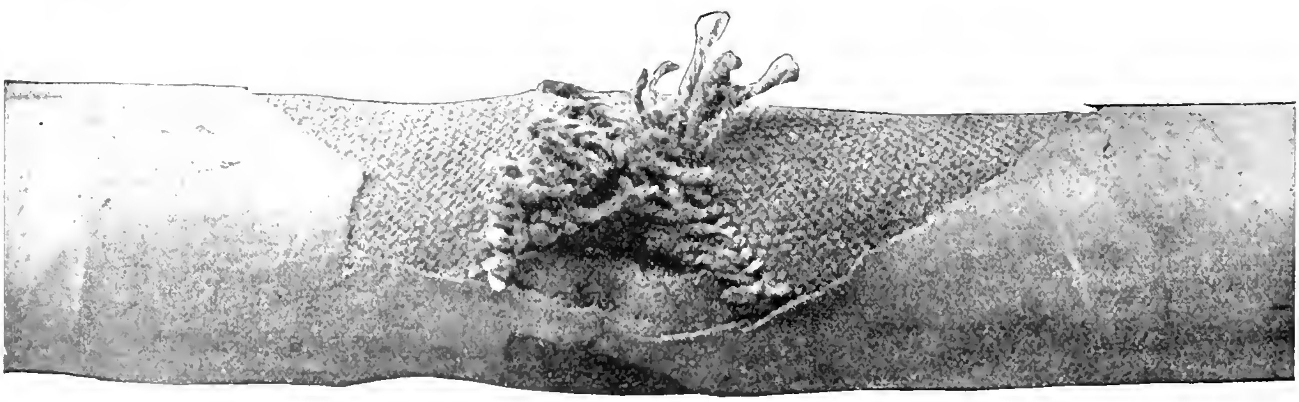


Interior view of $1\frac{1}{4}$-inch Air-Brake Hose, in service for two years and eight months on freight equipment.





Interior view of piece of Air-Brake Hose, showing injurious effects of burs on the shank of the nipples, penetrating and cutting the tube or rubber lining.



Showing cheap grade of Air Brake Hose made by competitor, where it burst at the end of the shank of the coupling.

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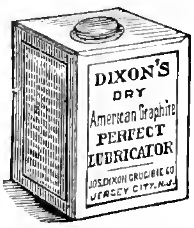

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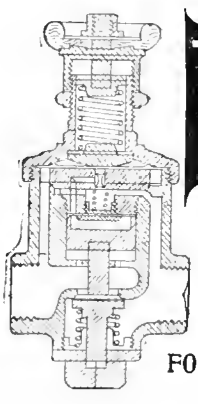

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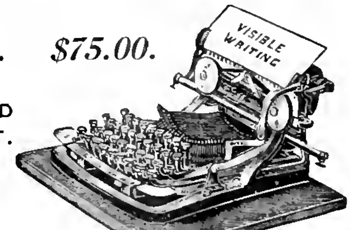

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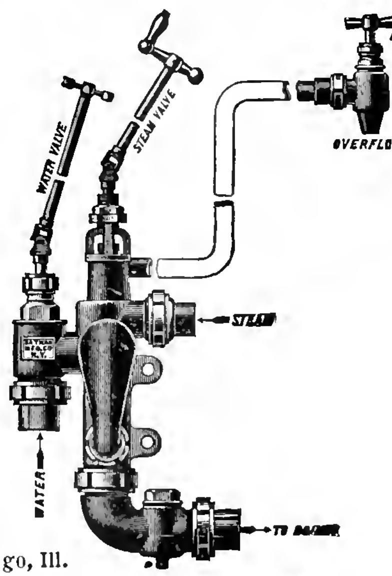

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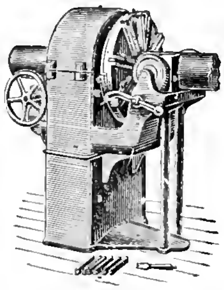

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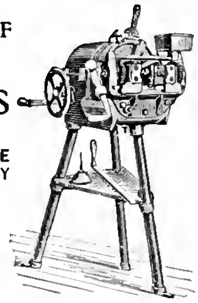

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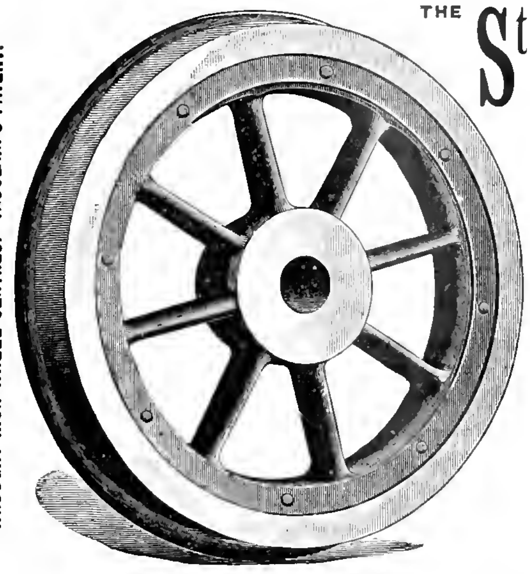

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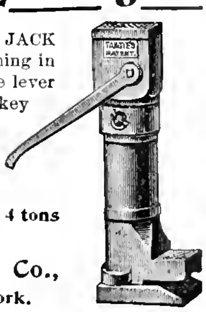

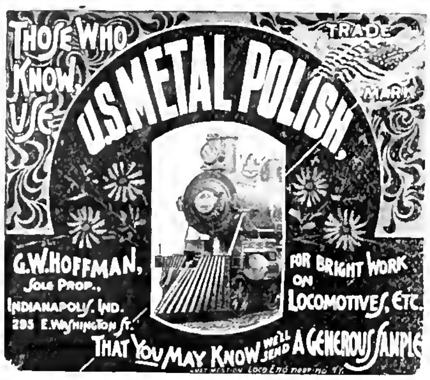

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Pump Valves.
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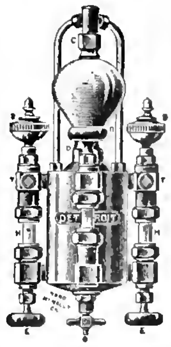

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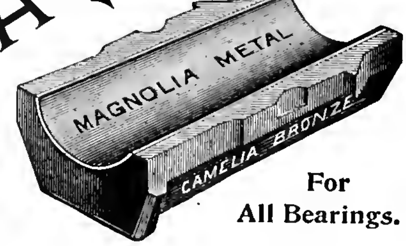

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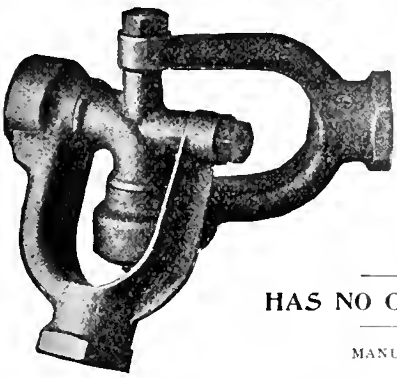
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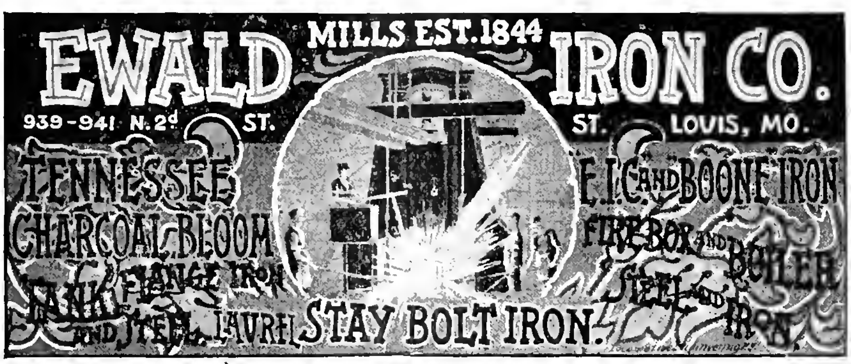

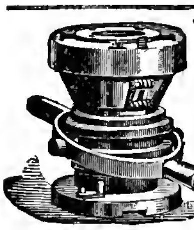
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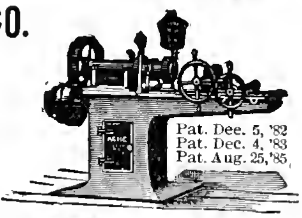
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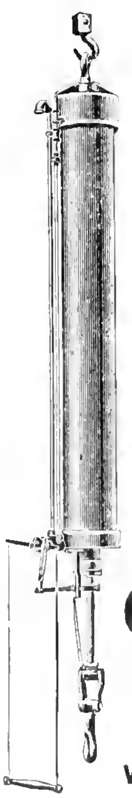

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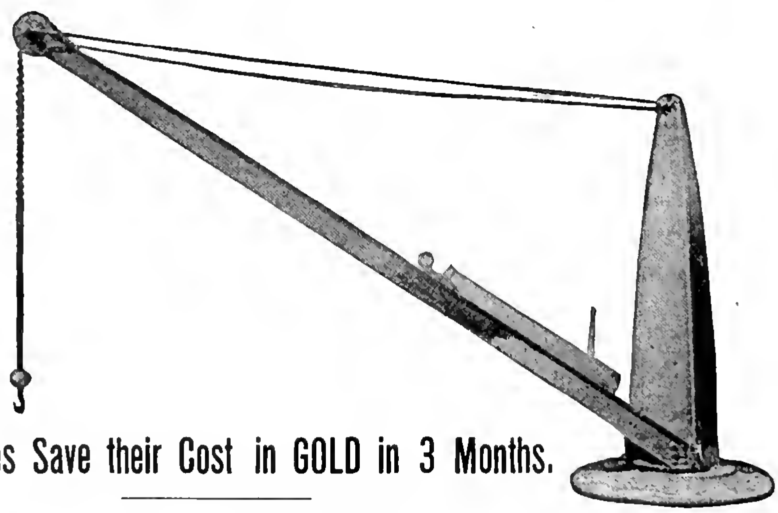

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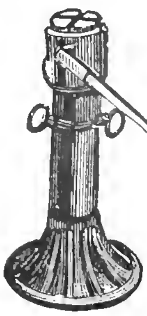
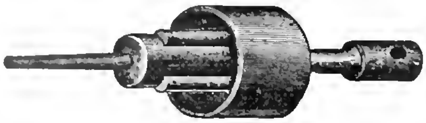

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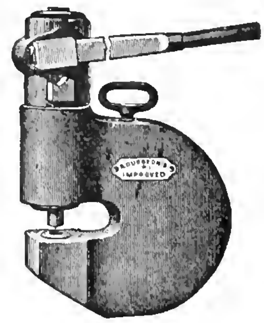

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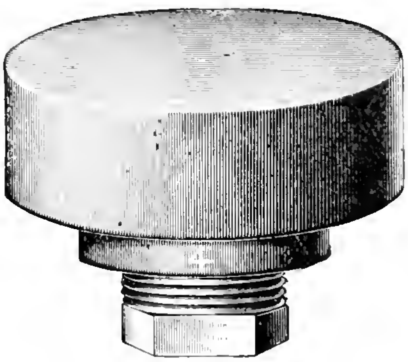

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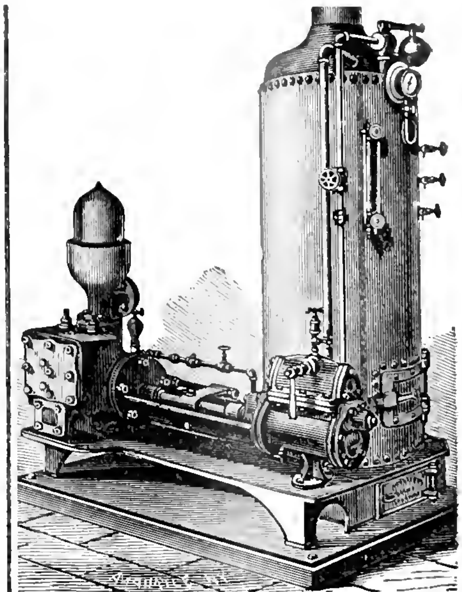
WILLIAM C. BAKER, successor to the Baker Heater Co., 143 Liberty St., New York.



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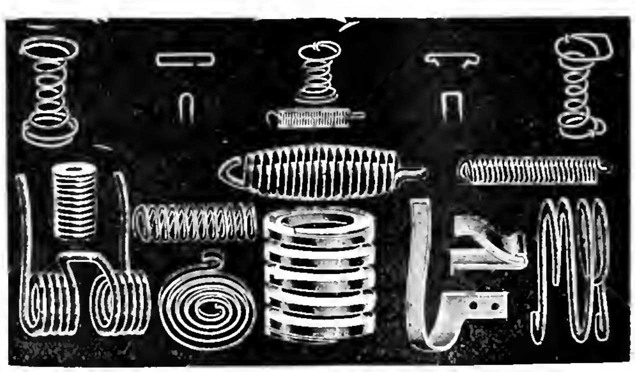

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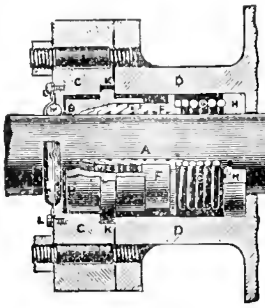

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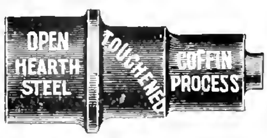

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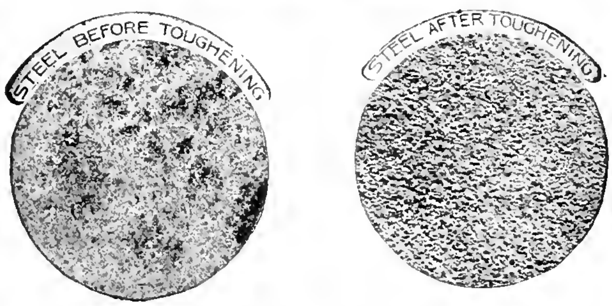

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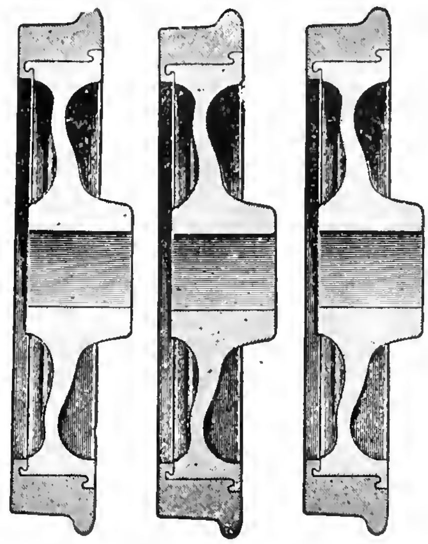

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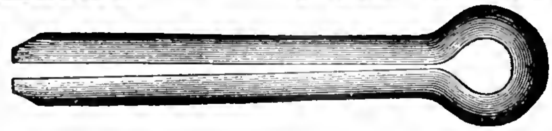

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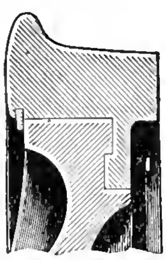

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Tires with Annular Web and Hook,
Best Charcoal Iron Double-Plate or Spoke Centers,
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A Continuous Circumferential Fastening. Simple, Safe, Economical.

CHILLED IRON WHEELS

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For Chilled Iron Wheels,

Outwear from 4 to 6 ordinary Shoes and enhance mileage.

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"The state of the art shows this lubricator to be in **lead** of its competitors for **simplicity** and **perfect working under varied conditions.**"

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THIS is the only single tube "Automatic, or Re-starting," Injector that will start with 25 lbs. of steam and work up to 200 without trouble.

IT is a plain, heavy business machine,—no small priming jets, pipes or valves.

ONLY 24 pieces—less than half the usual number of parts.

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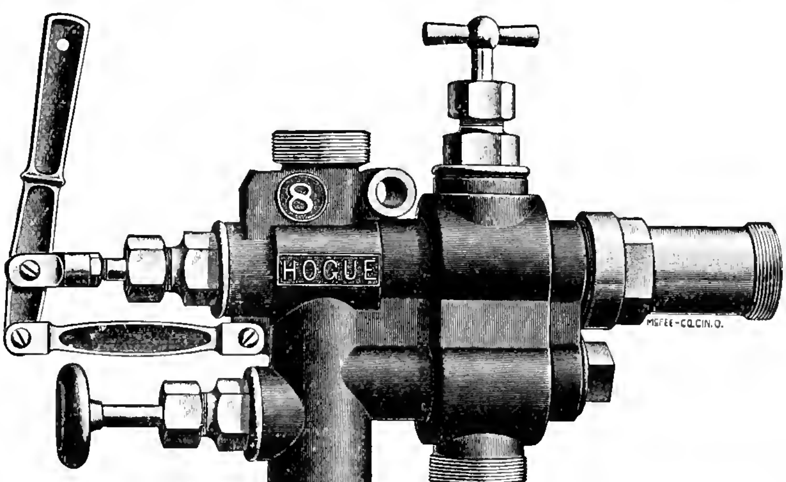
SIMPLER, lighter and the cheapest guaranteed Injector on the market.



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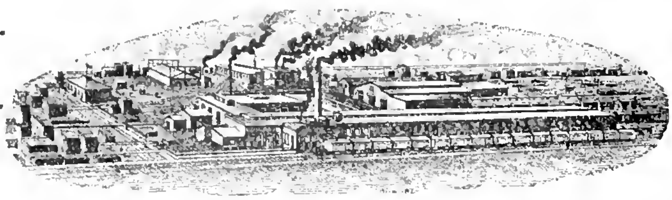

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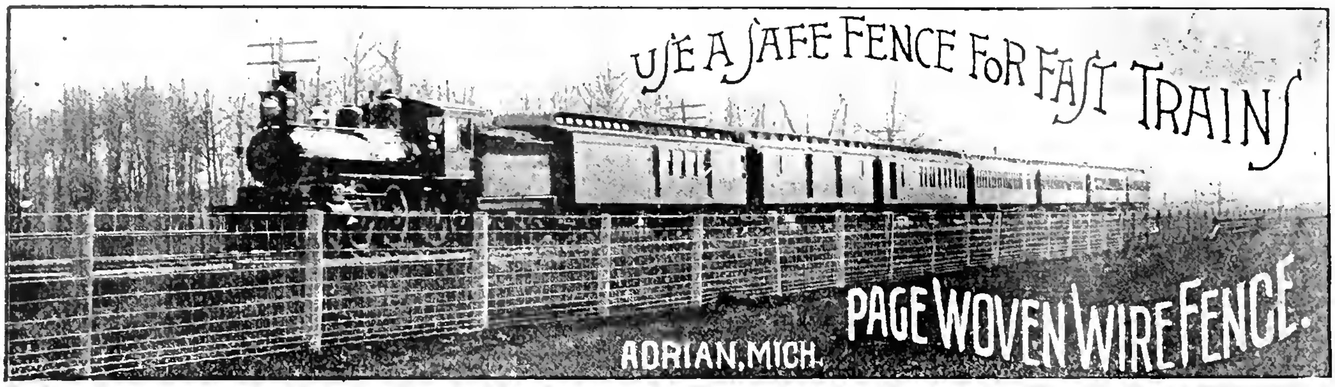

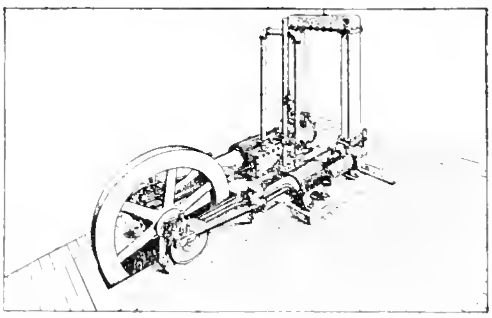

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This is the best construction for small and medium sizes.

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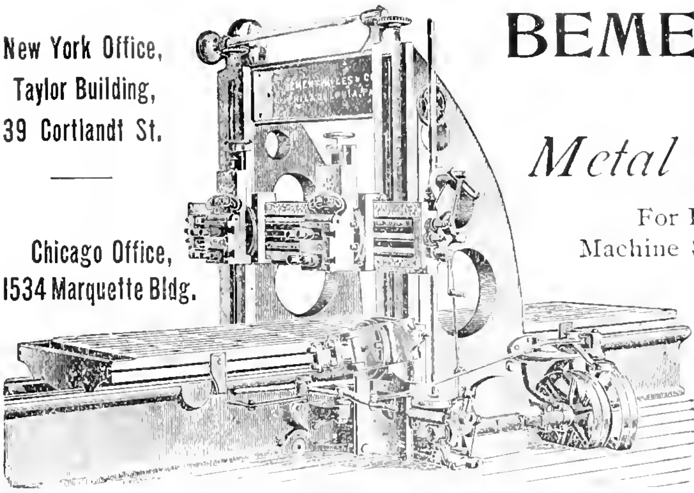

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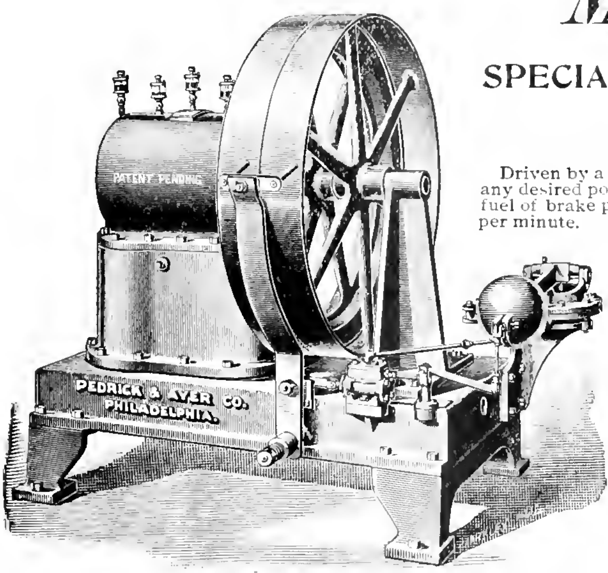

Requires no attention but oiling, and little of that.
Case Dust-Proof.

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That can be used under low ceilings, on a timber, the arm of a jib crane, etc. It locks and sustains load indefinitely, air or no air. Goes where regular hoist won't. An improvement all around. No chain hanging down in the way.

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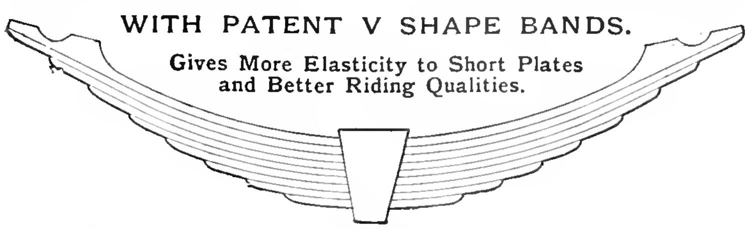
WITH PATENT V SHAPE BANDS.

Gives More Elasticity to Short Plates and Better Riding Qualities.



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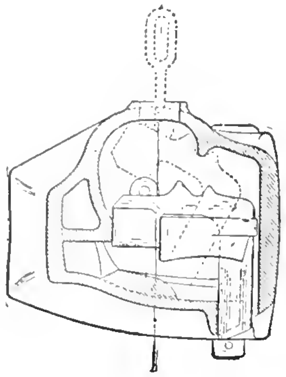

Sectional view back of lock looking forward. Dotted lines show the lock lifted full height for uncoupling and opening knuckle, and ready to couple again.

THE TOWER COUPLER.

Any competent mechanical engineer who examines with care the construction of this coupler, finds that all the requirements of service have been met in most ingenious but simple ways. It compares with other automatic couplers, as a high-grade Columbia or Victor bicycle compares with a child's velocipede.

It couples easily, smoothly and surely when the cars are brought together. Under no circumstances are repeated attempts to couple necessary. Delays to trains and shocks to passengers and freight from this cause are entirely avoided.

STRENGTH—Equalling in tests the highest records of "all-steel" Couplers, and surpassing them in jerk and pulling. DROP TEST—Three 5-foot blows; three 10-foot blows; six 15-foot blows of 1,640 pounds weight. GUARD ARM TEST—Three 3-foot blows and four 5-foot. JERK TEST—Three 5-foot, 3 10-foot and three 15-foot blows. PULLING TEST—174,200 pounds.

The bar is of malleable iron of uniform best quality, and so placed as to give the greatest possible strength. Knuckle lock and pin are of steel.

In uncoupling, the lock itself throws the knuckle open, no separate piece of any kind being required. The action of the lock, both in coupling and uncoupling, is quick, positive and sure, under all conditions.

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Is now prepared to fill orders, at an hour's notice, for One or One Thousand Sets of

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having, at their New Works, an annual capacity for turning out Air Brakes for **250,000** Freight Cars, **6,000** Passenger Cars, **10,000** Locomotives; besides repairs for the **350,000** Freight and Passenger Cars and **26,000** Locomotives already equipped by

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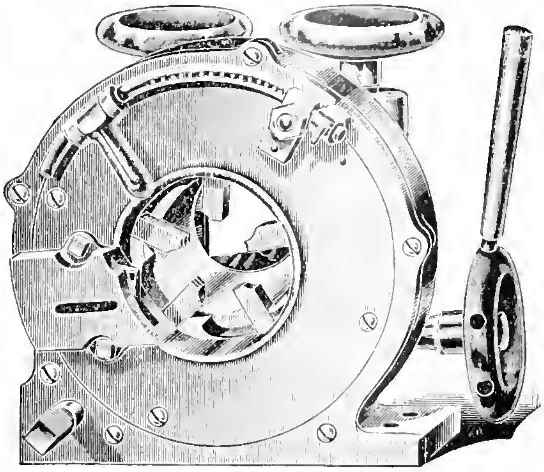

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FOR HAND, FOR POWER
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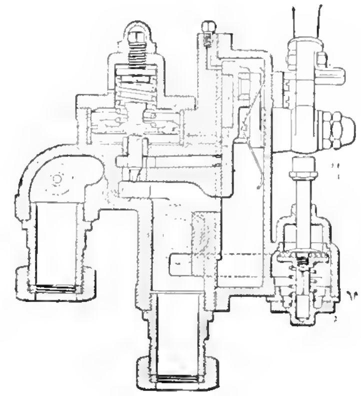

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Send for Price List.

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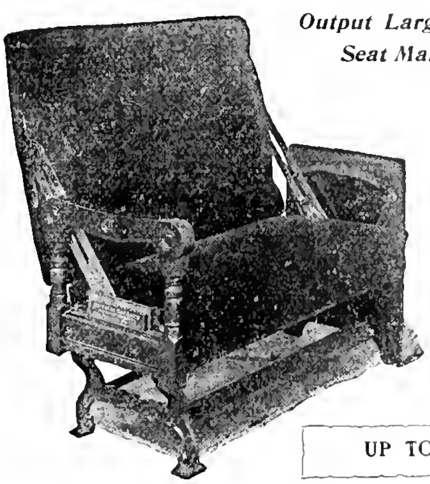
Finest Coach Parlor Car Sleeping Car Street Car Rattan Elevated Seats

PLUSH - RATTAN - ELASTIC SLAT

With either 'Reversible' or 'Walk-Over' Back.

Output Larger than All Other Seat Makers combined.



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SUPERIORITY PROVEN BY POPULARITY.

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Our "Standard" Pattern is the Finest of its class.

See cut of "Walk-Over" here next month.

EITHER IS BETTER THAN ANY OTHER MAKE.

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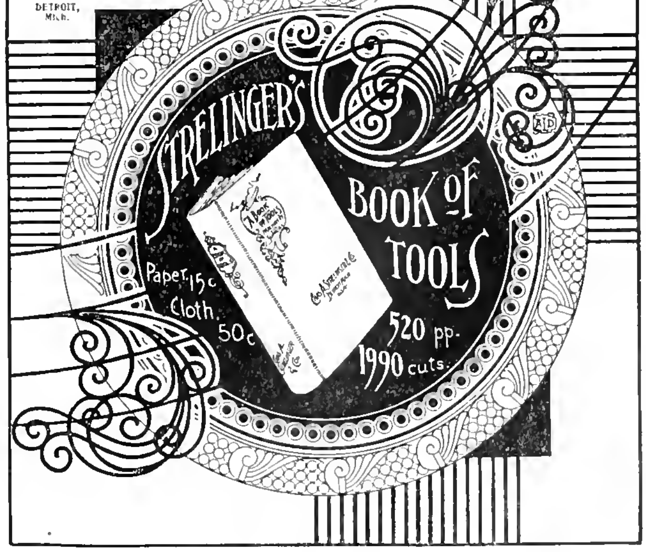

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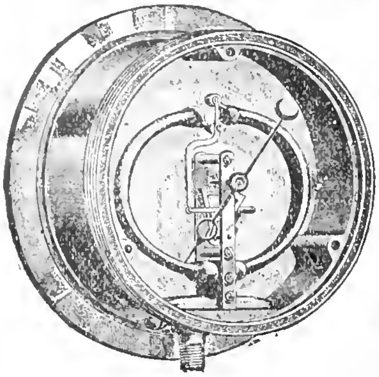
Double Bourdon Spring and Elastic Packing Ring.

SPECIAL SEAMLESS DRAWN TUBING.



Only Gauge where Movement Frame and Spring are removed from contact with back of case.

ELASTIC PACKING MAKES CASE AIR TIGHT.

No Dust or Moisture Enters.

HYDRAULIC AND AMMONIA GAUGES.	SPRINGS OF FINELY TEMPERED STEEL.
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SPECIAL STEAM BOILER APPLIANCES.

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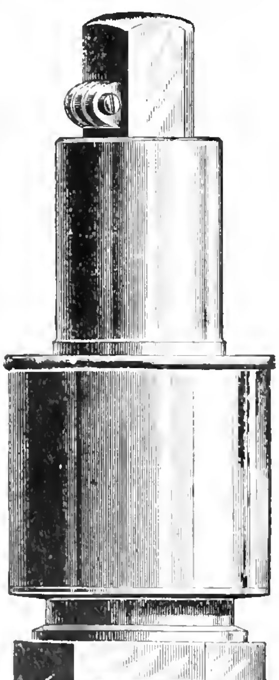
THE MUFFLER IS A SIMPLE ATTACHMENT TO RICHARDSON'S WELL-KNOWN ENCASED



SAFETY VALVE.

NEAT, COMPACT, DURABLE.

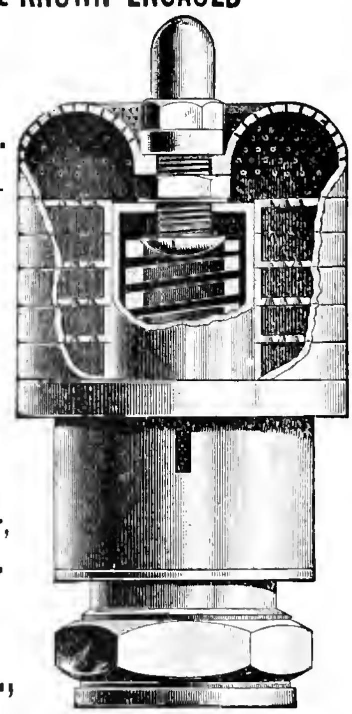
RECEIVED HIGHEST AWARD AT COLUMBIAN EXPOSITION FOR DESIGN, MATERIAL, WORKMANSHIP AND FINISH.

The Celebrated 999 of New York Central

IS FITTED WITH THIS VALVE AND MUFFLER, AND THE VALVE AND MUFFLER HAVE BEEN ADOPTED AS STANDARDS BY THE ROAD.

Also adopted by the N. Y. N. H. & H., the Lehigh Valley, the N. Y. L. E. & W. and the Boston & Albany Railroads.

SAMPLE VALVE AND MUFFLER SENT ON TRIAL SUBJECT TO APPROVAL.



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PRESSED STEEL MATERIAL FOR CARS.

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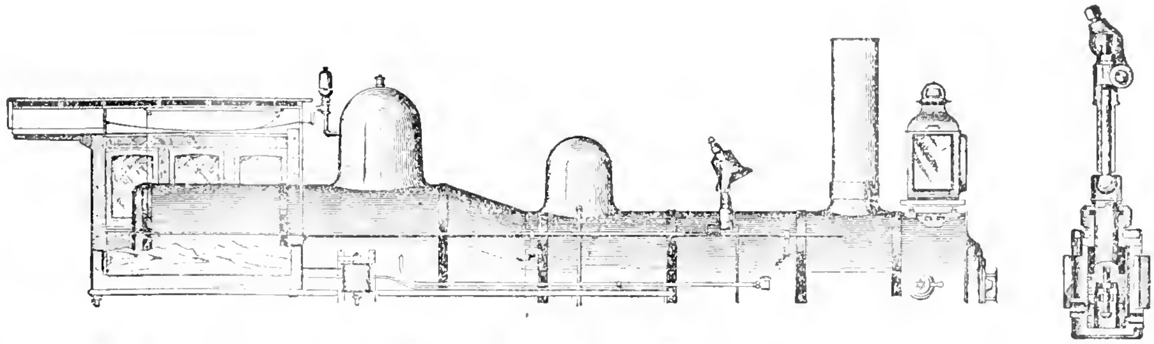

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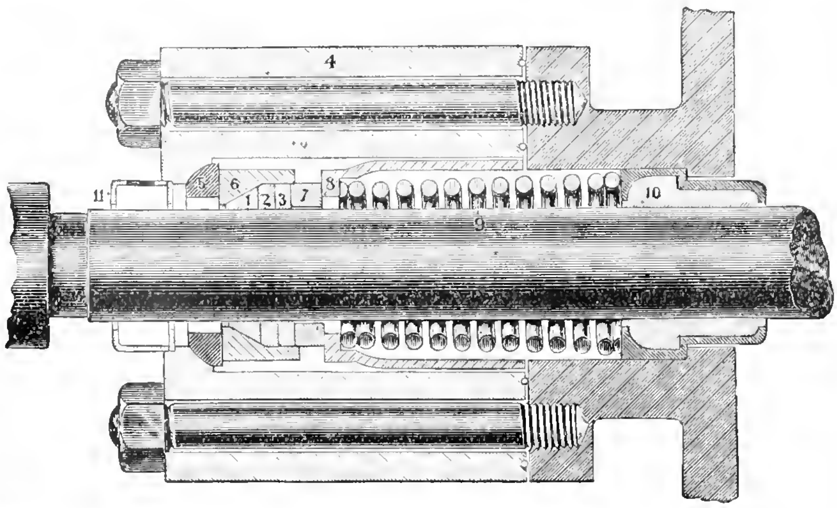
THE GOLLMAR BELL RINGER.

Simplest device for the purpose yet devised.
Starts automatically when whistle is blown. Costs less for repairs, and the cheapest to apply. No bell-rope required,—sure starter.
Protection in lawsuits, automatic feature insures bell ringing at crossings—no other ringer can start automatically without our license.

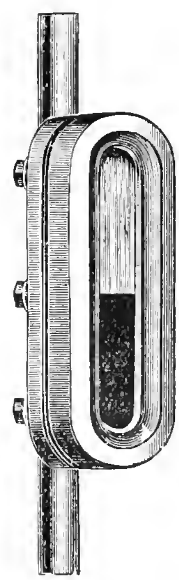


UNBREAKABLE GAGE GLASS.

Will go in place of old glass tube. With 350 degrees of heat on inside a stream of ice water will not break it. One glass is a permanent part of the locomotive.

Economical, efficient and safe.

A trial will convince anyone of its merits.



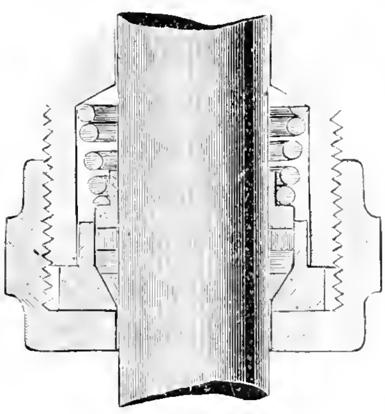
"United States" Valve-Stem Packing.

Friction of rings back of the support of rod, improved oiling arrangement, swab protected from dust and dirt, shield in one piece but can be removed for renewal of swab in an instant. Same on piston packings. This packing has stood the test of years, thousands in use. You take no chances in using it—tried and true.

METALLIC PACKINGS

save their cost in fibrous packing in a year. They do not injure the rod. They require no attention but oiling. They put less friction on rods, never score and are tight.

Ask for our Catalog.



Air Pump Rod Packing.

Giving A1 satisfaction on several roads. Saves time, labor and rods. Worthy of a trial. Try it.

Beveled Packing Ring

Simple, Self-Supporting,
Durable, Standard.

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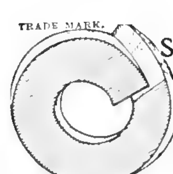
San Francisco, Cal. or Jersey Shore, Pa



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GOULD'S
Steam and Water Packing

Patented June 1, 1880.
Especially adapted for Locomotives.
Never sticks the Throttle.

The Original Ring Packing.

In ordering give EXACT diameter of Stuffing Box and Valve Stem.
None genuine without this Trade Mark.

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A CENTRAL DRAFT AUTOMATIC COUPLER with Positive Self-Opening Knuckle without the Use of Weight, Spring or Lever, will open on any grade up to 1200 feet to the mile.

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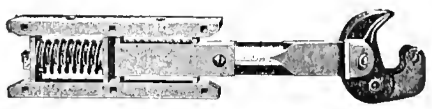
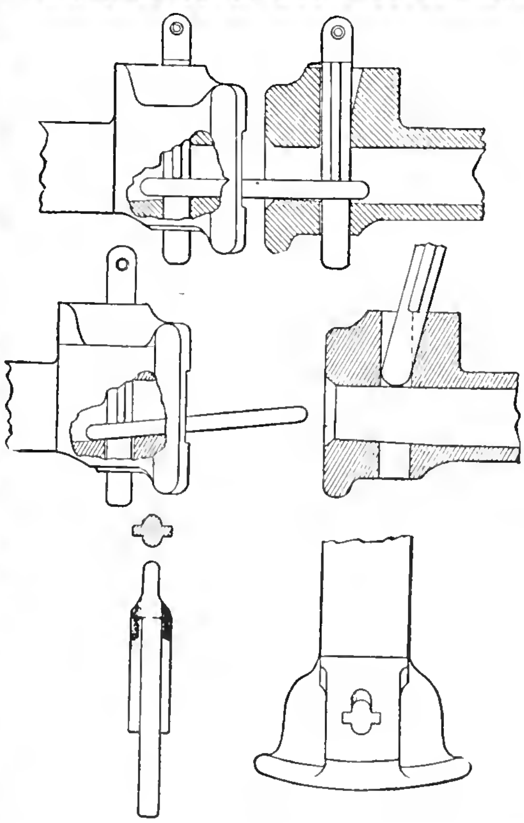


MINER DRAW BAR ATTACHMENT.

LUDLOW FREIGHT COUPLER.

THIS ATTACHMENT HAS BEEN IN SERVICE FOR THREE YEARS WITHOUT A SINGLE BREAKAGE.



Sams Automatic Car Coupler

Possesses these features:

Absolutely Automatic.

Validity of Patent, and as to its meeting the requirements of the U. S. Law, has been passed upon by prominent Legal authority.

Ten Systems now using it.

An assistance to Car each side, as the Link is always in position to enter opposing Draw-Bar.

Overcomes 5 ins. lateral variation, and 4½ ins. vertical: and also has free slack.

The best and only Automatic Coupler to use for repairs in connection with the present Link and Pin.

We give Systems the right to make and use Draw-Bar and Lever attachments, and sell them the Pins.

Completely does away with the necessity of the men going between cars to couple and uncouple them.

Cast-Iron Bars weigh about 185 lbs.; Malleable, 135 to 140 lbs.

Can furnish Malleable Bars at $4.25 each, F.O.B. Chicago. Pins, $1.00 each, F.O.B. Detroit.

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GOULD COUPLER CO.

WORKS:
Steam Forge, BUFFALO, N. Y.
Malleable Iron, DEPEW, N. Y.
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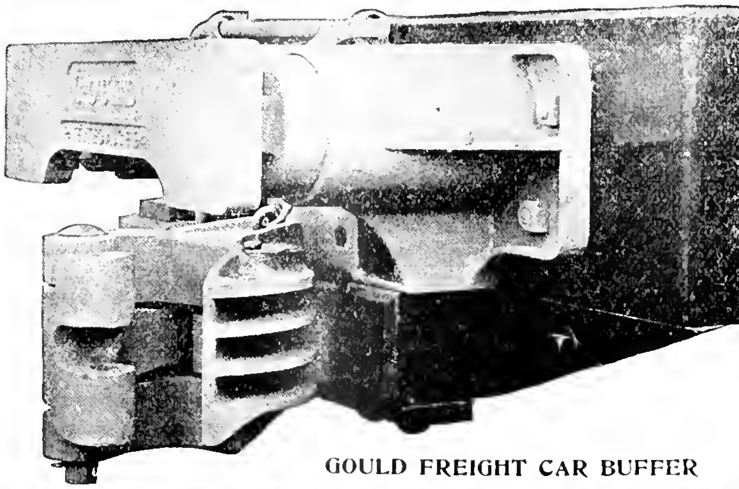

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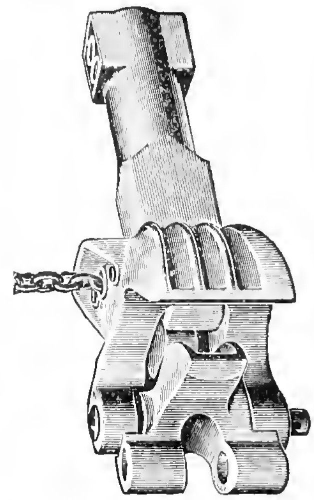
THE POOLEY COUPLER

POSITIVELY AUTOMATIC.



MADE FROM THE BEST MATERIAL.

The Longer in Service the Better it Operates.

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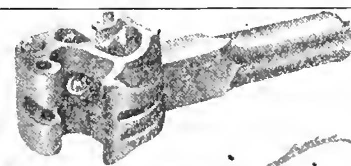
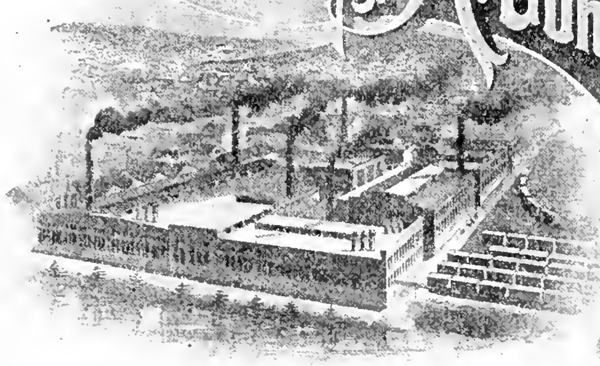


The McConway & Torley Company



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MALLEABLE IRON CASTINGS.
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THE JANNEY COUPLER
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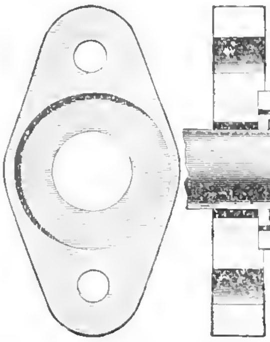

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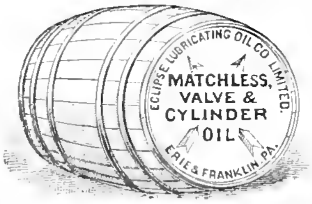

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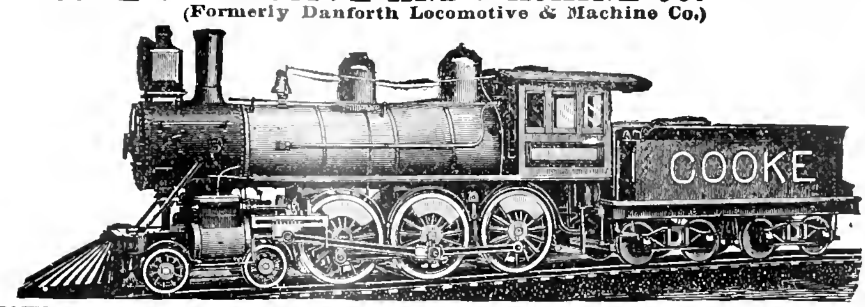

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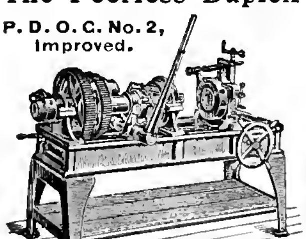

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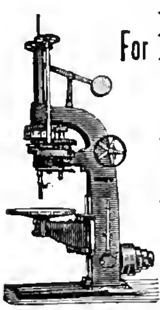

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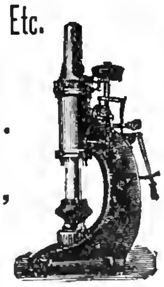

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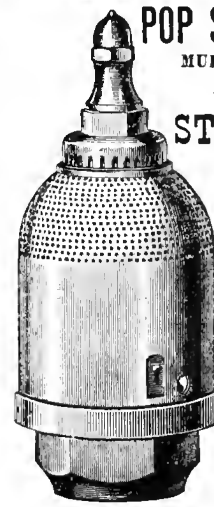

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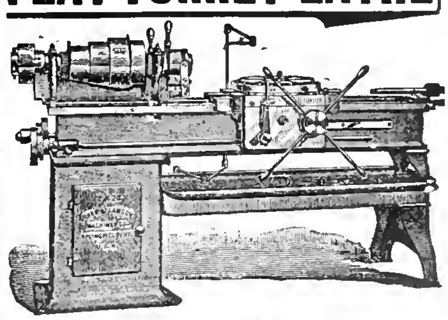

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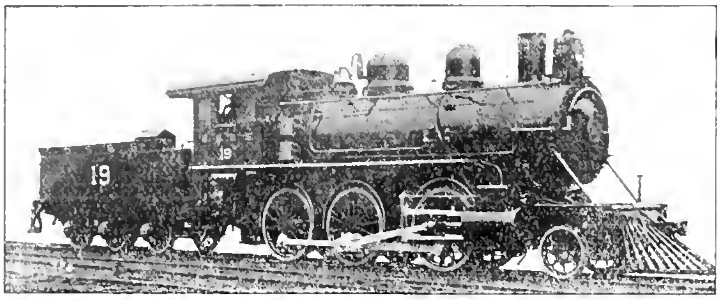

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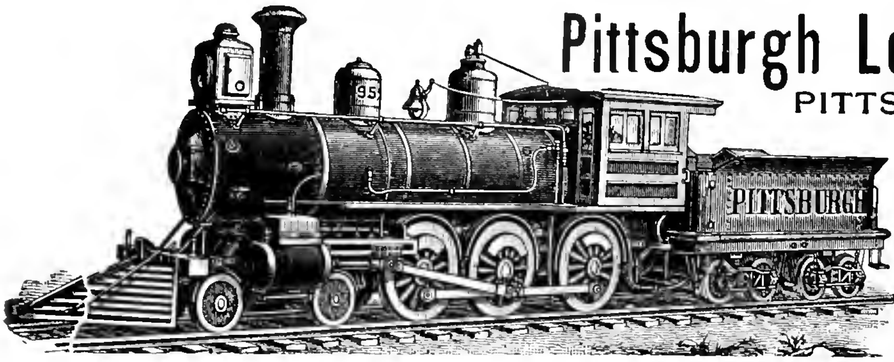

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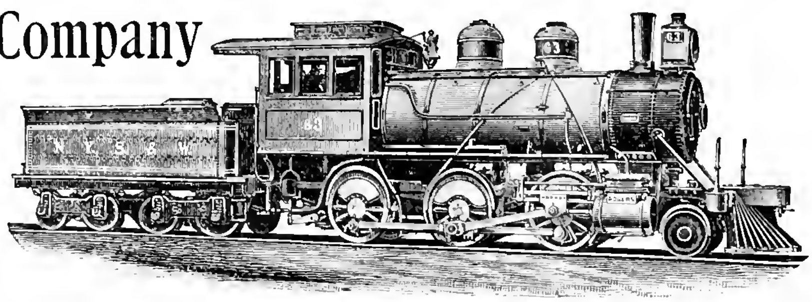

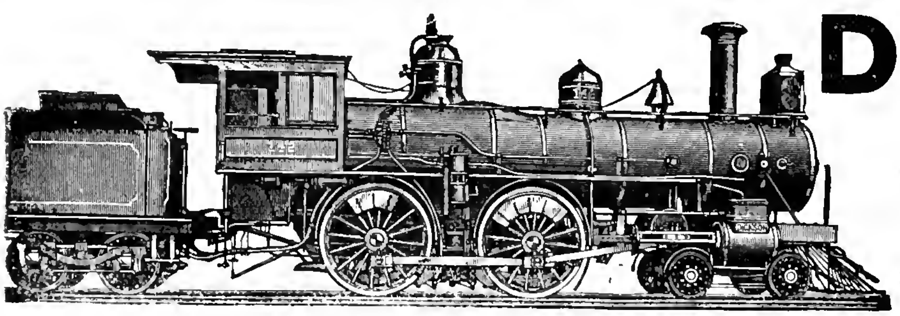

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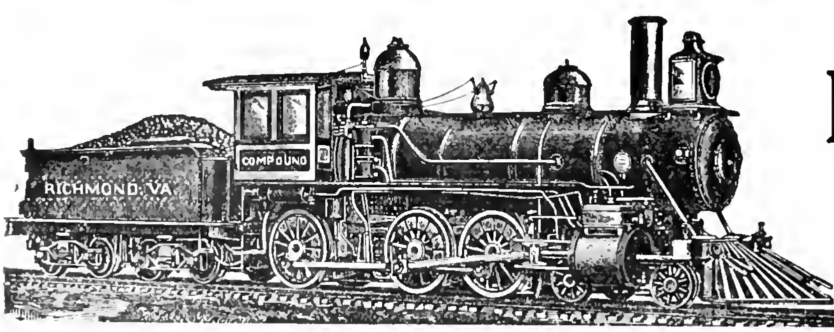

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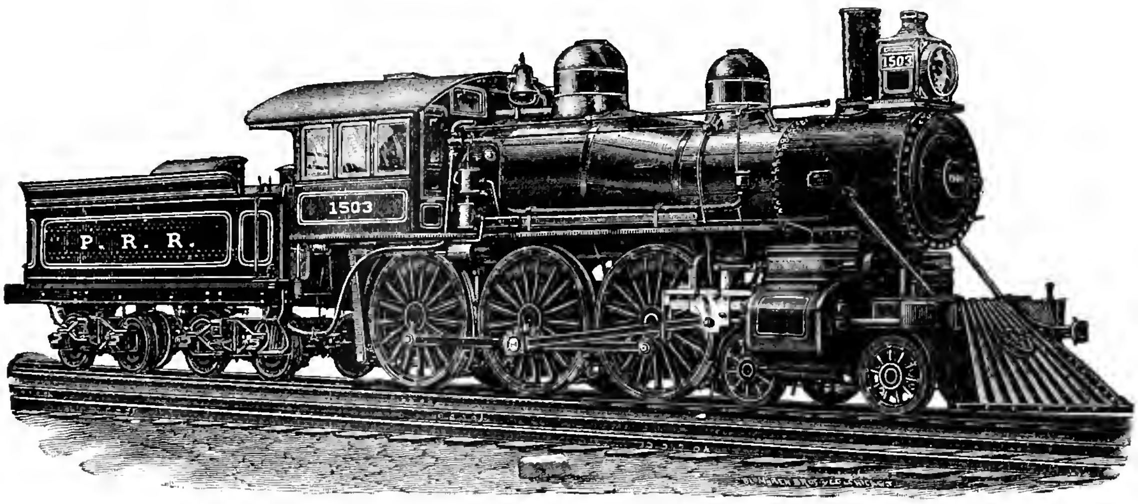

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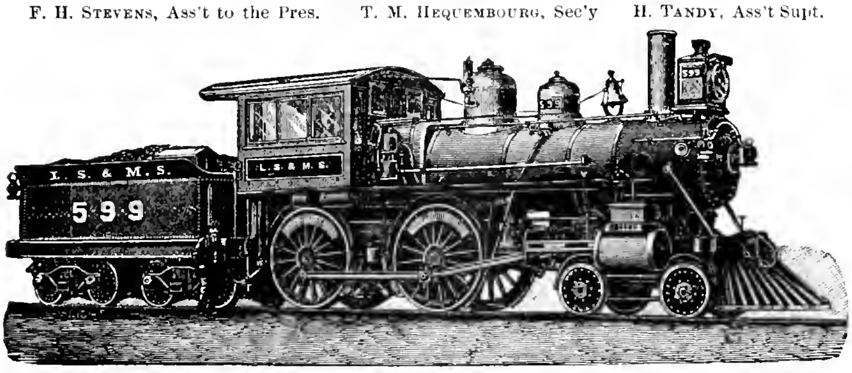

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[Trade-Mark Registered.]

Vol. VIII. 256 BROADWAY, NEW YORK. No. 9.

Seaboard Air-Line Passenger Engine.

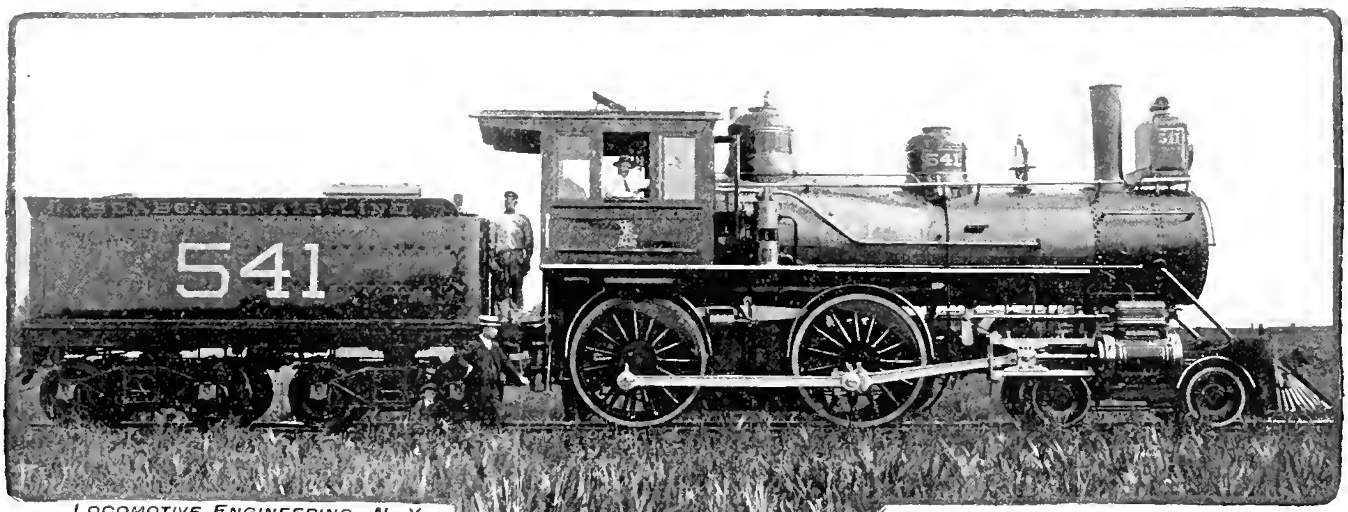
The engine shown in the annexed engraving is one of a class designed by Mr. W. T. Reed, superintendent of motive power of the Seaboard Air Line, for handling heavy, fast passenger trains, and built by the Richmond Locomotive Works. There are eleven others of the same kind just delivered. The engine is remarkably well proportioned, with cylinders 19 x 24 inches, driving wheels 68 inches diameter, and truck wheels 30 inches diameter. The driving-wheel base is 9 feet 2 inches, and the total wheel base 24 feet 1 inch. The total weight of the engine in working order is 118,000 pounds, of which 76,000 pounds are on the drivers. With a boiler steam pressure of 180 pounds to the square inch, the engine will exert a total rotative force of a little over 19,000 pounds.

The boiler is of the wagon-top variety, made of Shoenberger steel $\frac{9}{16}$ inch and $\frac{5}{8}$ inch thick for the shell, which is 58 inches diameter at the smokebox end. The dome is $32\frac{1}{2}$ inches diameter and 26 inches high. All the longitudinal seams are butt-jointed with double covering strips.

The firebox is 78 inches long and 33 inches wide inside, and is made of Shoenberger flange steel. The side sheets and crown sheet are $\frac{3}{8}$ inch thick and the tube sheets $\frac{1}{2}$ inch. The stay-bolts are of Tennessee charcoal iron 1 inch diameter and set $4\frac{1}{2}$ inches from center to center. The crown sheet is supported by crown bars made of flat bar iron 6 x $\frac{3}{4}$ inch. There is a brick arch supported by angle iron and a baffle plate over the door. The engine steams freely with a single nozzle $5\frac{1}{4}$ inches diameter.

The specifications called for Krupp driving-wheel tires and Standard tires for the engine-truck wheels. Coffin-process axles are used throughout, and Ajax metal for bearings. The boiler is fed by two Monitor injectors, and Nathan sight-feed lubricators are used for valves and cylinders. The slide valves are Richardson balanced, the eccentric straps of Ajax metal. The U. S. metallic packing is used for piston rods and valve stems. French springs are used throughout, and Morris lid for axle boxes. The engine and tender are equipped with the Westinghouse air brake and air signal. The Player brake beam is used with Ross-Meehan shoe and Christy head.

All the fittings and equipment are arranged with a view to make everything comfortable and convenient for the men handling the engines.



LOCOMOTIVE ENGINEERING. N. Y.

SEABOARD AIR LINE LOCOMOTIVE.

DESIGNED BY MR. W. T. REED, SUPT. MOTIVE POWER.

A Mountain Road in Pennsylvania.

Many of our readers are not aware that there is such a thing as a wilderness east of the Rocky Mountains; that there are mountains in Pennsylvania covered densely with fir and hemlock, almost without roads, and filled with paths known only to hunters; but such is the case.

The great hemlock forests of Western Pennsylvania have not been half cut off yet, although for a score of years lumber concerns have had mills at work on the edges, and great tanneries have felled thousands of trees for the bark.

Through the heart of this country the Buffalo & Susquehanna road has recently been built, and in many respects it is a remarkable road.

Its owners, F. H. & C. W. Goodyear, two hard-headed business men of Buffalo, long ago became interested in lumber lands and a mill on the western edge of the forest. They were the first to see the need of a tram road and a locomotive, because the snows could not be depended upon to help get the logs to the streams nor to furnish the freshet to float them to the mill. They built a short tram line, and bought a little "dummy" engine weighing eight or ten tons to operate it with.

This road was the forerunner of others; up this gulch and that, roads were built to handle logs. Wooden rails disappeared and second-hand iron from neighboring

"really" railroads took their place. Shay geared engines did better than the dummy, and large log cars enabled them to haul bigger loads. Steam loaders facilitated the handling of logs and increased the business, and everything grew.

Some of the tram roads developed a local business and were left and improved, others were pulled up as fast as the timber disappeared. In the course of a few years there were ten Lima (geared) engines at work, and a freight engine, bought from a neighboring line, was doing a sort of limited main-line business.

The line now became known as the Sinnemahoning Valley Railroad.

About two years ago the owners of this road decided to build their main line through to make connections with other neighboring roads, their only outside connection being at Keating Summit with the W. N. Y. & P.

The road that they built is the best new road, and has been equipped with the best power the writer has ever seen on a new line.

The rail is 80-pound Dalley section steel, most of the bridges steel or cut stone. The stations are away above the average, and they are building one at Galeton and another at Wellsville to cost $8,000 each.

The new shops at Galeton are the best small shops I ever saw. The buildings are of brick, resting on cut stone foundations and having all the modern conveniences.

The engines are ten-wheelers for passenger service and consolidations for freight, and are known to the enginemen (who were brought up in the woods here on geared engines) as "straight" engines. These freight engines are the finest that Baldwin can build. I should say that there were from $800 to $1,000 worth of "extras" on each one of them. They are painted in two colors, striped and gold-leafed; all outside trimming is bright iron, and the cab fittings are nickel-plated. Every engine has a fine clock and every improved device extant, with the single exception of water scoops.

In building over the mountain between Austin—the old headquarters—and Ansonia, the connection with the Fall Brook, they put in three switchbacks on one side and two on the other. The track is good and the speed reasonable.

The men handling these engines deserve great credit for the way they have posted themselves on air and main-line work, for they do handle their engines and the brake well.

It is remarkable to find sixty-odd miles of new road so finely equipped as this. Another new line is being laid now, some forty miles long, to connect with the Erie at Wellsville.

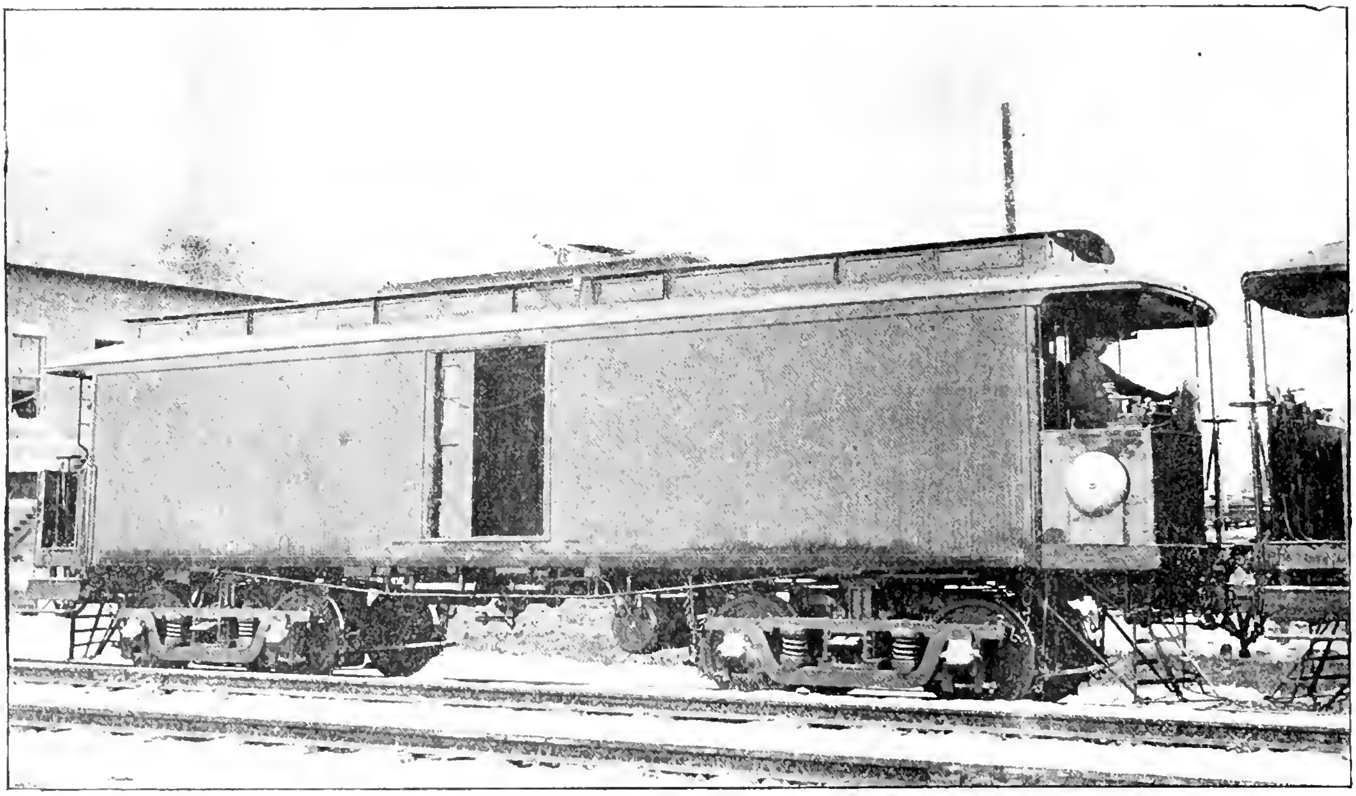
Probably nine-tenths of the business of the road is logs and lumber belonging to the Goodyear Brothers; the tanneries, kindling-wood factories, etc., of course furnish something.

The first question a stranger asks is, What is to become of this fine piece of road when the lumber is gone? And the conclusion is reached at once that it will be useless; but the connections this road makes furnish a line between Philadelphia and Buffalo, some sixty miles shorter than any other, and this, in its day, may cut some figure. The existing lines are tied up by traffic agreements, but the projectors of this road don't generally get left on a business proposition, and probably know what they are doing.

Mr. John D. Campbell is general master mechanic, and was just getting settled into the new shops when I visited him. It is a splendid plant, and when gotten into running order will be able to handle lots of work—and there is lots to handle. Geared engines are subject to a thousand ills that straight engines won't take, and the way they eat up gears and other parts is rather appalling to a man not used to them.

They will climb a tree, however, and are the best engines on earth to wreck with or to place cars or load material—you can move them to the fraction of an inch, full power, and, like a wheelbarrow, they stop when you drop the handles.

J. A. H.



Nantasket Beach Electric Motor.

The Latest So-Called Electric Locomotives.

That our readers may know what is going on in the electric locomotive line, we show here two types of electric engines recently turned out.

The Nantasket branch of the N. Y., N. H. & H. was recently changed from steam to electricity, and the newspapers have been surcharged with electrically-lighted obituaries of the steam locomotive in consequence.

The Nantasket "engine" is no more nor

less than a large trolley car, with a heavier motor than is usually employed on street cars. This motor car hauls another car or two, runs some seven miles, and does very well for this service—perhaps better than a locomotive, for it is possible to run more frequently one and two car trains.

The other motor is a much more pretentious affair, weighing, as it does, ninety-five tons, and having been designed to haul regular trains through the B. & O. tunnel at Baltimore. This monster is also a "trolley," albeit the biggest "what there is." It has given a lot of trouble and is not yet doing satisfactory work, but the trouble is undoubtedly with minor details that will shortly be remedied.

There are hundreds of thousands of every-day people who think that "electricity is taking the place of steam," and that soon locomotives and stationary engines will be cold in death, fuel useless, and a "motor" doing all the work. There are even some railroad men who expect to see many of our present locomotives rust to death instead of being worn out. Most people do not take the trouble to "think" along the trolley wire, to inquire where it goes to, or what it goes for. Those who do, always find that it ends up against a steam engine somewhere, and that it goes after electric energy, put into it by a dynamo—a steam engine doing all the work.

A little inquiry soon shows that the electric current is only a convenient means of conveying power—a belt—and that power can be best and most economically developed by a steam engine.

Further research develops the fact that it is quite impossible to send this current over a trolley wire for more than five or six miles with any economy—the current leaks away and becomes weak. The longer the line the weaker the current toward the outer end, and the higher or stronger the current the more it leaks.

The electric current can be generated by compound condensing engines, supplied with steam from ample boilers under natural draft, for less money than power can be developed by any steam locomotive; but the so-called electric locomotive supplied by it is yet like a captive balloon—it can go the length of its rope, and no more.

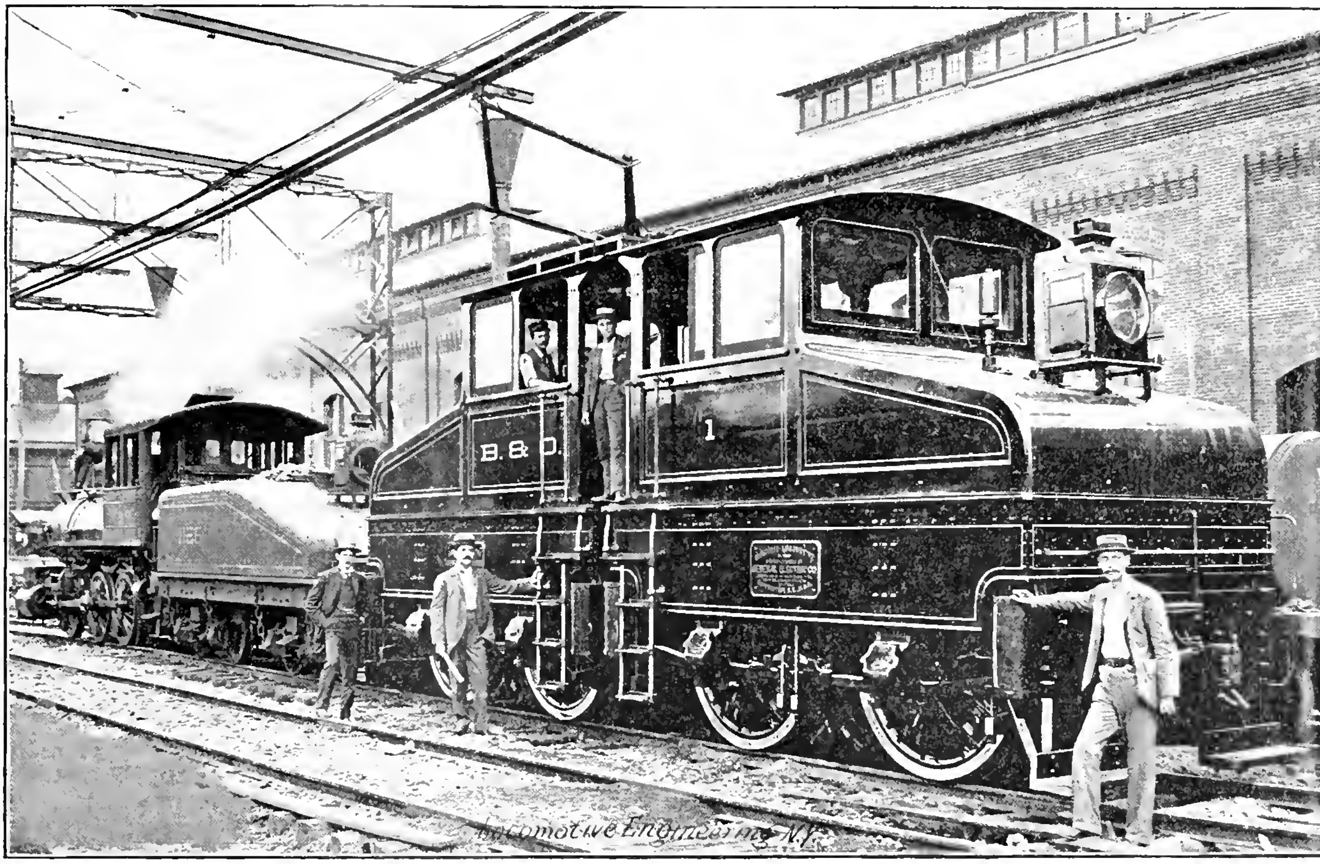
For suburban business, where light, frequent service is needed, electricity is better and cheaper than steam motors, and will and ought to be used; but the electric motor that is to run at lightning speed, and haul the ordinary trains of our trunk lines over divisions a hundred or more miles long, has not yet been built nor invented.

Electric locomotion will be an evolution; it will grow little by little, doing all that can be done with it in its present stage of development; but don't worry about its doing away with the locomotive yet.

Of course, someone may stumble upon the solution of the problem to-morrow, and make a motor that will develop its own power direct from fuel so much cheaper than a steam locomotive does that it will pay to throw them all away; but remember that it is also possible that someone may perfect a flying machine that will put the electric and steam locomotive both under the same shed with the stage-coach and the Connestoga wagon.

When the electric crank comes to croak at your wake, ask him where he gets his electricity—lots of them don't know.

These two so-called locomotives are the latest and best types of electric tractive power. The B. & O. affair has an air pump, brakes, etc.; the whistle is blown by compressed air, and it has some resemblance to a locomotive, or a pair of switcher tanks; but it is no more capable of hauling a train between New York and Chicago in competition with a steam locomotive than is a box car.



Baltimore & Ohio Electric Locomotive.

The Atchison, Topeka & Santa Fé have concluded to build new shops and a round-house at Arkansas City.

We consider that the Master Car and Locomotive Painters' Association is doing excellent work for the interests the individual members serve, but they seem to be straining a little on subjects for discussion. A subject for discussion at the next convention is: "Would one be justified in sanding the bull nose on the roof of a passenger car for durability's sake?"

Some Shop Notes.

The Minneapolis & St. Louis Railroad Company have a modern little plant at Minneapolis that will not suffer by comparison with older and larger concerns.

Master Mechanic Long is well to the front in the way of special tools, the most of which originated right there. If a tool, jig or gage is wanted to cheapen the cost of work, it is built or bought at once. He never ties any strings on General Foreman Williams, who is remarkably fertile in getting up little kinks that save money, and are in use after they are made, not in the scrap, where they go in some shops after a brief parade.

It is only necessary to show the need of some better way to do work, when consent is forthcoming at once; the result is that few shops can show up a more complete lot of special contrivances for doing good work.

The first thing that strikes the visitor is the number of air hoists in operation. These hoists are made of 5-inch gas pipe, 42 inches long, traveling by means of a trolley on a ½ x 4-inch rail placed over tools in a convenient position. There is one at the axle lathe, one at the slotter, one at each planer arranged so that two can be used at the same time if needed, one at the larger drill and two at the wheel lathe. These last are placed so as to handle the tail stocks in either direction when that operation is necessary, by the wire passing around sheaves placed so as to give the proper direction to the pull—a unique application of compressed air.

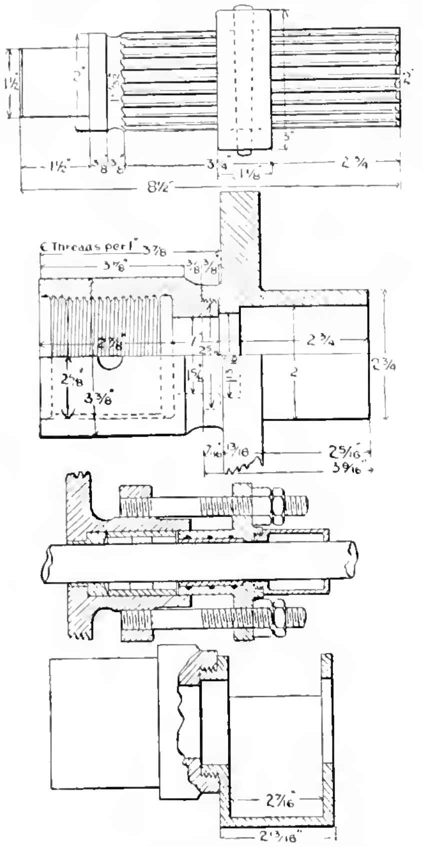
The lift at the axle lathe has a travel of about 40 feet, and a gripping device at the lower end of piston, on the ice-tongs principle, that takes an axle from the pile and gets it in the lathe, or out of the lathe when finished, with a dispatch that was never approached in the old way.

There is a machine used here, devised and built by Mr. Williams for drilling out stay-bolts or frame-bolts and for general use about the shop, that has made a record for itself when taking out fireboxes, in which all bolts in a crown-bar box have been drilled out (through outer shell) in thirty hours.

This reads like a fairy tale, but it is on the books. The machine is made up of a combination of a 4 x 5 plain slide-valve vertical engine, driven by air, and a wrought-iron frame carrying the drill spindle and feed apparatus; the frame taking the place of the familiar and unreliable "old man," that could always be depended on to shift or fall down. This frame is supported on and secured to a cast-iron base having grooves and slots; the grooves are guides for wheels on which the frame travels, and the slots, similar to those in a planer platen, are used to firmly bolt the rig in position when at work. The frame extends high enough to allow the drill to reach the top row of stay-bolts, and the drill spindle has an adjustment to any angle up to 90 degrees.

Power is transmitted from the engine to the drill by means of a splined 1-inch shaft, having universal couplings. The engine is on wheels, making the whole device portable and easily moved about the shop. A counterpart of this engine, also driven by air, is used with a cold saw for squaring up the ends of heavy work.

Another rather novel use for compressed air was seen here, in the way that oil was furnished several tools. A 12 x 33-inch auxiliary reservoir was placed on end and used as an oil tank. The pipe from air supply was tapped into top of tank, from which pipes were led to the bolt cutters and nut tappers, the pressure on the oil being regulated at the tank, and the volume of flow handled at the machines. This is said to be superior to the old machine pumps, in that it is cleaner. The



floor around the tools seemed to bear out the claim.

An inquiry about the compressor furnishing the air for all these purposes elicited the word "Westinghouse." There are three pumps—two compounded—and a good reservoir capacity to draw from. They are still looking for places where air can be used to advantage.

Among the new wrinkles for lowering the cost of work was their way of getting up valve-stem glands. First, the glands were chucked, bored and threaded on outer end, in lots of twenty or more; they were then reversed and the threaded part screwed on a special chuck that was fitted to the lathe spindle, and taking the place of the face plate. While on this chuck the glands were turned for the stuffing-box fit and bored, with one roughing cut, leaving merely a scrape for a reamer used to bring them to a uniform size and depth. They were then ready for the babbitt, and taken to another special rig gotten up for the purpose. It consisted of a face plate, having a casting similar to the one on lathe spindle, to which the gland was screwed after being warmed. A lever arranged on the pump-handle order is fulcrumed so as to allow a mandrel to pass up through the center of gland, leaving a space around it for babbitt. After pouring, the mandrel is withdrawn by means of the lever to which it is secured, leaving a true, smooth hole, having just stock enough to clean up nicely for the valve stem. This plan of using soft filling instead of a brass bush has been in practice for some time. It is found that the wear is no greater for the same mileage than with brass, and the skill required to make a press fit for the brass bush is no longer needed.

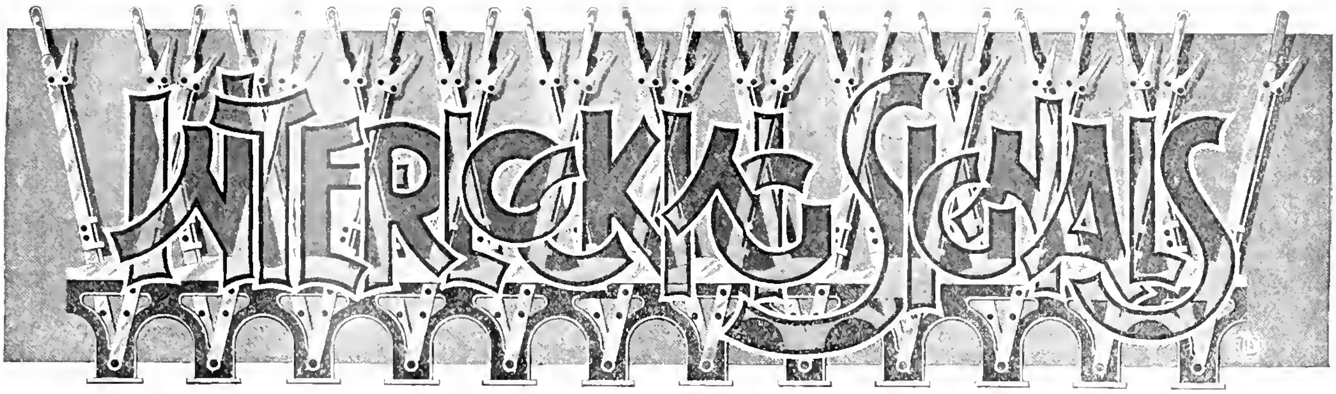
In addition to the uses found for the threaded portion of the gland, it forms a convenient seat for the cast-brass swab pocket, one of the best we have seen, and which no doubt contributes largely to the life of both gland and stem.

The matter of speeds and feeds has received some attention in these shops. There are no "buckskin" surfaces left from the lathe or planer tools; all surfaces are finished with the wide-nose tool and coarse feed, where practicable to do so, and there are few jobs on which they find it impossible to work in these time-saving features. These are factors in the economical management of a machine shop that are well recognized by those who know their business. There are few things, in our opinion, that so accurately measure the fitness of a foreman for his position as his ability to get work out of men and tools. O. H. R.

The guarantee that a rubber hose for air or steam has been subjected to a certain hydraulic or pneumatic pressure is of very little value. That merely means that the canvas part is strong. It is not the canvas that deteriorates first and causes a hose to fail; it is the rubber. A service test, carefully recorded, which shows the wearing quality of rubber and canvas combined, is worth much more than any pressure test that can be applied.

There has been a strong tendency for several years past on certain railroads to restrict the privilege of granting passes to trainmen and other employés. A correspondent, writing to us on this subject, gives particulars which seem to prove that the rules restricting passes to employés and their families are most prevalent on lines where the managers are deeply interested in manufacturing concerns which supply goods to their company.

The Forestry Commission estimates that there are $30,000,000 worth of railroad ties used annually.



By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

What They Are For and How They Are Operated.

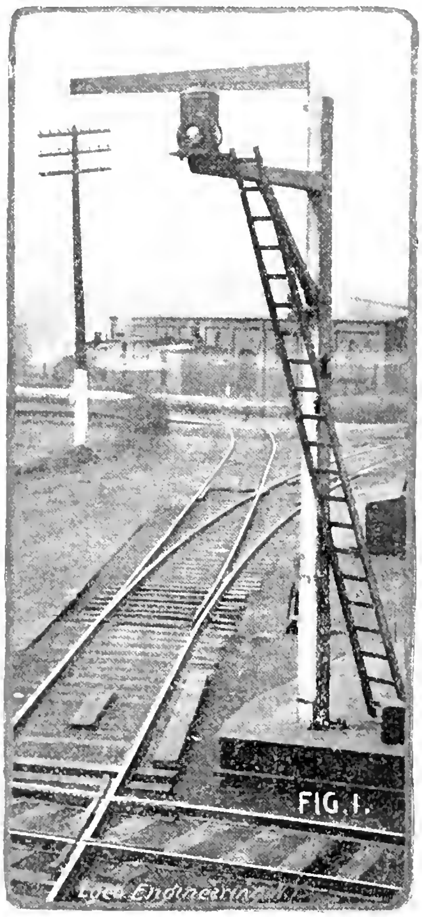
[NINTH PAPER.]

Interlocking signals, while they give authority for a train to proceed in the same manner as a block signal, differ from the latter in that they indicate the condition of the track, and not the state of the block—whether it is or is not occupied by other trains. If the switches are properly set and the signals cleared, a train has the right to proceed—not regardless of where other trains may be, but solely with respect to the condition of the switches on the route indicated.

Interlocking signals insure safety to a train using the track, by having the different levers and the switches and signals so interlocked that it is impossible to set the switches and clear the signals of any two routes at the same time, that would lead to a collision; by making it impossible for a signalman to clear a signal for a train to proceed until all the switches are in the proper position, and that after having so cleared the signal he shall be unable to change any of the switches leading to or connected with the track designated.

By the use of such a system it is possible to operate complicated crossings, important junction points or conflicting switches, so that trains can proceed without stopping and without danger of colliding with other trains. That their use is conducive to safety, and at the same time to handling the largest possible amount of business over a given set of tracks, can be easily seen, as no train is delayed to which the signals have been given, and any train not having the signals, although delayed, would not be delayed any more than if the interlocking was not in use—a delay to one train or the other being absolutely necessary, as is shown by the principle of physics, which we find so often demonstrated, that two pieces of matter cannot occupy the same space at the same time.

Practice in regard to the form of fixed signal used at interlocking plants does not vary as it does with block signals, the semaphore having been adopted as a standard for this purpose very soon after it was designed. While the semaphore is the standard form, practice differs, however, in the different countries, in the blade used to govern a given track. In this country, the blade projecting to the right, as viewed from an approaching train, is the one that governs; while in England, where the trains run on the left-hand track when there are two tracks, it is the one projecting to the left. The use of a fixed signal, to indicate to the engineer the posi-



A SIMPLE CROSSING SIGNAL.

tion of switches, having become standardized, the necessity of providing some means by which the signal could be worked from a distance very soon became manifest. With the growth of the railroads, and the consequent increase in the number of switches and signals, the levers used to operate them were, for reasons of safety and economy, concentrated at some central point. It was soon found, however, that this concentration introduced serious difficulties in the proper working of the levers that had not been thought of. Operators, through mistakes, carelessness, or perhaps by becoming confused, often pulled the wrong levers, sending trains on the wrong tracks, and occasionally causing serious collisions and very bad accidents.

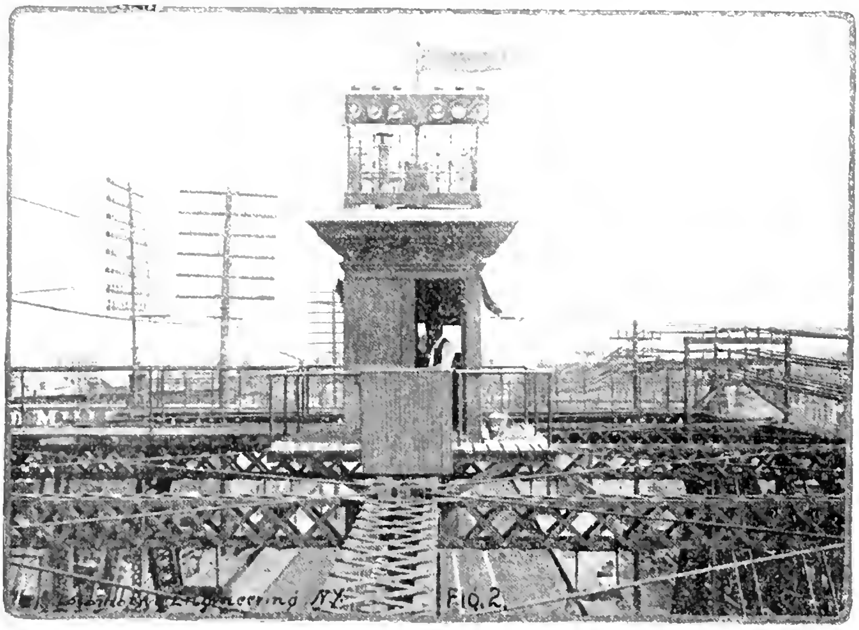
The first attempt at constructing an interlocking machine was made by Mr. C. H. Gregory, about the year 1842, and, although the design was very crude, it was not until 1859 that any decided improvements were made. In the year 1852 a simple lock was provided between the signal and a pair of switches, to prevent a signal being given contrary to the position of the switches. In 1853 an improvement on this was made, in which a notched bar, connected to the signal wire, was made to cross another notched bar, working in connection with the points of the switch—an arrangement that is the standard practice to-day.

Patents were taken out in 1860 by Mr. Austin Chambers, and also by Mr. Saxby, for an interlocking lever frame, the levers being interlocked so that no signal could be given contrary to the position of the switch. The interlocking of the switch and signal levers, as found in the present interlocking machines, was not arrived at until the year 1867, when Messrs. Saxby & Farmer took out a patent for a form of spindle-lever locking, and Messrs. Stevens & Sons a patent for their tappet or cross-bar locking.

In both of these forms the locking is accomplished by attachments made directly to the main levers, but owing to the great strain it was possible to put upon the parts, and the consequent necessity for making them large and strong, an improvement was made the fall of the same year, by which the locking was connected to and operated by the latch instead of the lever, the movement of the locking bars taking place before and after the movement of the lever. This form of locking is what is known as "preliminary" or latch locking, and is the one used in all the better class of machines. The locking of the one manufactured by the Union Switch & Signal Company is an improvement of the

Saxby & Farmer mach'ne, those made by the Johnson and the National Switch & Signal companies being a modification of the Stevens & Sons patent or "tappet" locking.

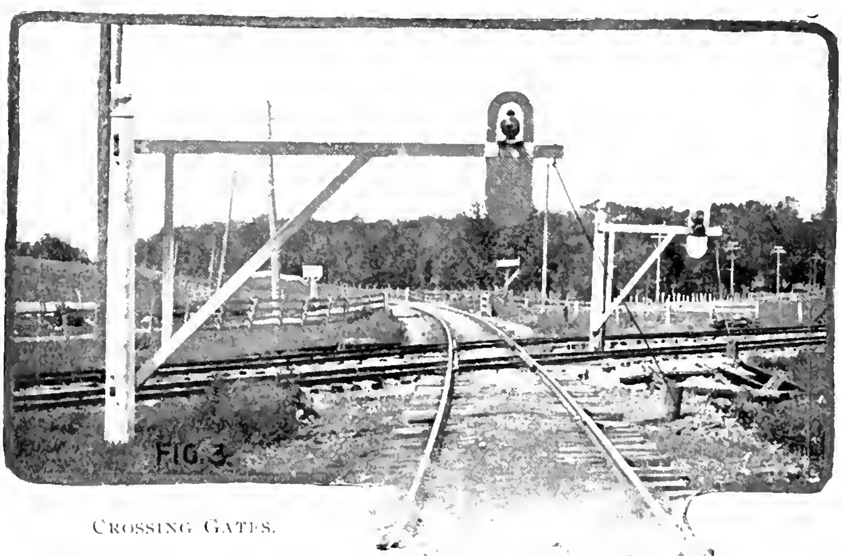
With the improvement of the interlocking machine, the design and construction of the several parts used in connecting the levers of the machine with the switches and signals has advanced with equal rapidity. Not only have safeguards been provided by which it is impossible to give a clear signal until the switches are properly thrown, but it is now made impossible to throw or change any switch under a moving train. All the parts are made to move with the least possible friction, and, while of comparatively light construction, the skillful distribution of metal to withstand the strains given the apparatus has resulted in the making of a very safe machine.



Although the principles of construction are fairly well defined, almost every installation of an interlocking plant calls for some expert opinion as to the proper arrangement to be used in connecting up the switches and in deciding on what signals are necessary to control the trains using them. It is in doing this work that the true province of the signal engineer lies, for not only is there a large chance for the unnecessary use of material, but unless the different routes have been properly signaled, trainmen will make mistakes in reading the indications, and accidents will result.

In point of fact, so great is the leeway—not only in deciding what switches shall be connected, what signals shall be used and what locking of the levers is necessary—that many States have given their Railroad Commissioners power to devise rules covering these points, and to see by a personal inspection that all plants are safe and conform to their views. The Board of Trade of England is a very noted example of this, for its jurisdiction extends to the particular form of block-signal appliances and methods to be used in controlling the movement of trains, as well as to a supervision of the interlocking plants used at crossings, drawbridges, junction points and sidings.

That such is necessary or advisable is, in this country at least, a debatable question, as very rarely is it that these bodies are composed of men who understand the requirements of signaling, and if a mechanical expert is employed by them, he will often advise a construction that is not only expensive, but is practically of little benefit.



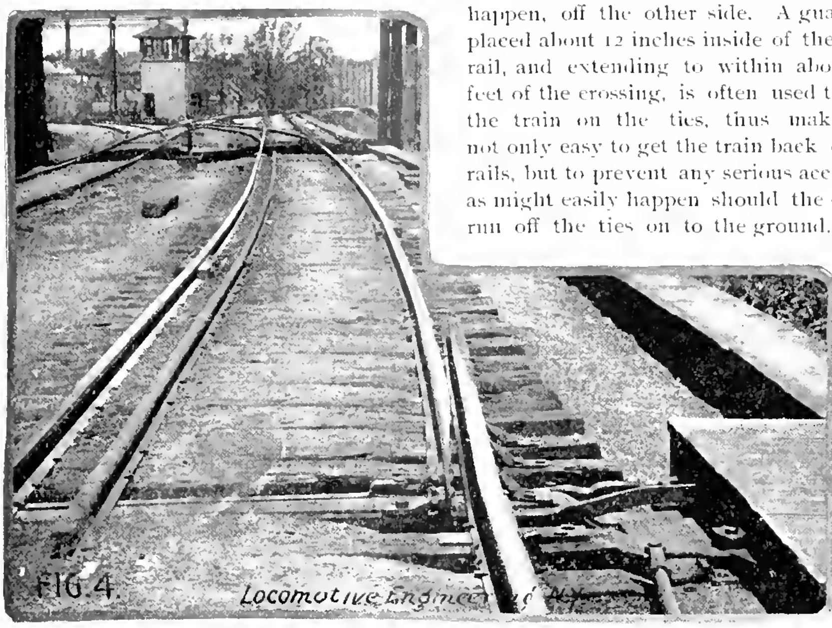
Crossing Gates.

Laws that require all trains to stop at crossings unless protected by an interlocking, or that a railroad desiring to cross another shall not be allowed to do so without installing an interlocking plant, are but right and just, in view of the danger to which the traveling public would be exposed if such measures were not taken.

That laws should be enacted that all trains should stop at crossings, drawbridges and at important junction points is indeed wise and for the public good, judging from the numerous accidents that have happened whenever this precaution has not been taken; but to go to the extent of passing laws, as has been done by the Legislatures of some of our States, that all trains must stop at crossings, etc., without recognizing the protection afforded by an interlocking plant, is merely retarding the advance of the railroads and increasing the cost of running trains in those States.

To consider, first, the protection of a simple crossing of two single-track roads by interlocking signals, it will be found that the principles involved are much the same for all plants, no matter how complicated the crossing, the fundamental idea being to have everything safe for the train to proceed, after giving a clear signal, and that if it cannot be made safe, the signal must remain at danger and the engineer be compelled to obey the indication and stop. With roads doing a light business, or where the vision is not obscured, very often no protection of any kind is provided, as it is much less expensive to have all trains stop before going over the crossing. Where business is heavy, or because of the locality it is desirable to indicate to or signal a train that it can have the right to the crossing, some form of fixed signal is necessary, as signals given by hand may be misconstrued. There are many varieties of signals used for this purpose, that shown in Fig. 1 consisting of a blade or arm, made to extend over the track which it is intended to block, leaving the other road free for trains to pass. The lantern seen on the top of the pole is provided with red glasses, which are lowered in front of the lamp, to change the white light to red for the danger signal, in the direction in which it is desired that trains shall be held. This method of showing a red light is particularly objectionable, as was clearly demonstrated during the switchmen's strike last summer, as there is no interlocking between the slides, each one being independent of the other, and it is, therefore, very

easy to show a white light in all directions at the same time. A much better arrangement is to provide a lantern having two red and two white lenses, so that it can be turned through a quarter of a circle, as there can then be no chance of making such a mistake.



Derailing Switch and Guard Rail.

Another form is that shown in Fig. 2, in which the arm seen above the lamps is used to designate which road may and which may not use the crossing, the crossing in this instance being at a very acute angle. Of the six lamps, three have red lenses and three green, the green lamps being on the side opposite from the arm, and designate at night which road has the right to the crossing.

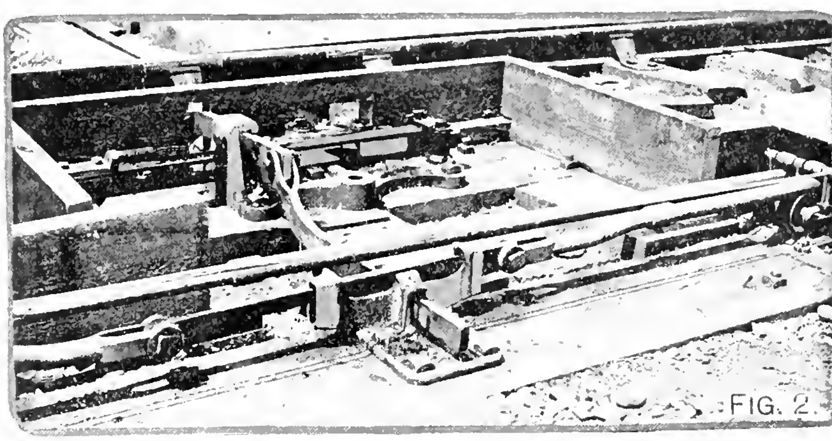
Still another form, and one that is very common in the West, is that of the two gates shown in Fig. 3, a gate being provided for each road, and both roads being normally blocked until the approach of a train, when the gate on that road is turned one side.

With all signals such as these, while it may be impossible with the majority of them to make a mistake and give a clear signal to both roads at the same time, there is nothing to compel the engineer to obey the signal or to stop, in case he should disregard it or, through accidental causes, be unable to stop. That there is great danger of this happening, is evidenced by the large number of crossing accidents that are reported from time to time.

With the modern interlocking appliances, obedience to the signal is made compulsory by means of a derailing switch, which, unless it is properly closed, will derail the train, running the wheels off the rails on to the ties. Such a device is shown in Fig. 4. It consists of a single switch point, put in one side of the track, so that, unless it is closed, it will catch on the inside of the wheel, causing both wheels to leave the rails. It is usually placed on the engineer's side, unless, owing to the location, it is desirable to have the train derailed, when such a thing does happen, off the other side. A guard rail placed about 12 inches inside of the other rail, and extending to within about 100 feet of the crossing, is often used to keep the train on the ties, thus making it not only easy to get the train back on the rails, but to prevent any serious accidents, as might easily happen should the engine run off the ties on to the ground. This practice, in the light of present experience, is not to be recommended, unless the location is such that it would be almost as bad to derail the train as to have a collision on the crossing, for it has so happened with several derailments that the engine and, at times, part of the train have run clear over the crossing and blocked the other line, simply because the train was kept on the ties by the guard rails. With the simple crossing under consideration, as trains will approach it on each track and from each direction, it is necessary to provide four signals, one on each side, to govern trains intending to cross. These signals, from the fact that they are stop signals, and must not be passed unless at clear, are called, as in block signaling, "Home" signals. These have blades with square ends, and are usually painted red. As there are four signals, there must be four derails—one for each direction in which it is possible for a train to approach the crossing.

Ordinarily, the derails are placed 300 feet from the crossing, although a greater distance than this, or about 500 feet, is advisable, if it is desired to stop every train that is derailed before it reaches the crossing and obstructs the other line; 300 feet, however, is the minimum distance used at any high-speed crossing. If there is a descending grade towards the crossing, the derail should be located further away so as to give the same measure of safety as for a track having level grade. The signals, where practicable, should be located on the engineer's side of the track, and not less than 50 feet nor more than 200 feet ahead of the derail or switch which it governs. The object of this is to allow an engineer a little leeway in making the stop; for while he is expected to stop at the signal, and not pass it, he may run by it, in which case he would not run off the derail until he had gone past the signal further than he ought, the fact of his getting off demonstrating beyond all doubt that he did not approach the signal at proper speed.

To make it impossible to clear a signal unless the switches which would derail the train are properly closed, a bolt lock is connected to the points of the switch, which prevents the signals being moved from the danger position until the switch point is closed, and, when the signal is cleared, locks the points of the switch so that it is impossible to open them. The bolt lock is formed of two notched bars which are made to cross each other in a suitable frame, and is shown in Fig. 2. One bar is connected to the signal, and the other to the points of the switch, and it is impossible to move either one unless the other is in the position in which it should be.



A Pipe-Connected Bolt Lock.

Distant signals should be provided in all cases where trains are permitted to run at high speed, to give warning to the engineer of the position the home signal may be found in, so that he can, if necessary, be prepared to stop at the home signal. These are usually placed 1,200 feet in advance of the home signal, although this

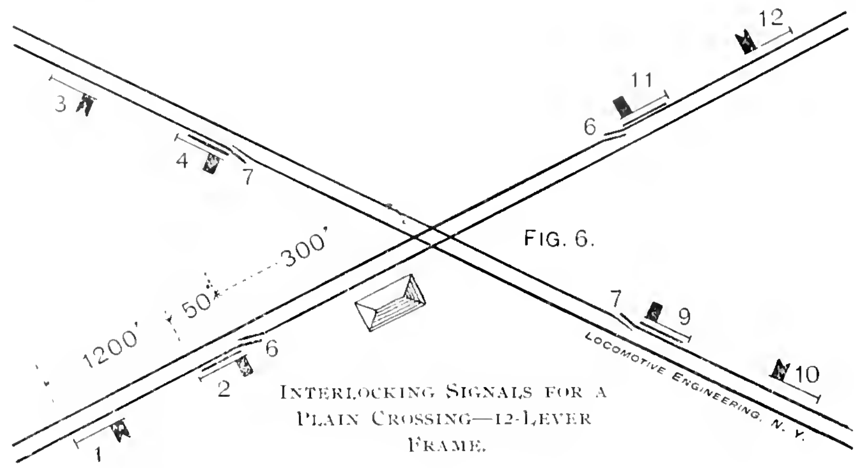
distance, with the high speeds and the heavy trains which are being run to-day, is not sufficient in which to bring every train to a stop should it pass the distant signal at speed, so that a greater distance than this is preferable for even ordinary locations.

If, now, the derails, the home and the distant signals are connected to the levers of an interlocking machine placed in a tower, which should occupy a central position, it will be seen that we are in a position to control all the movements of all trains wishing to use the crossing. For the sake of distinguishing them, the levers of the machine are all numbered, commencing with those on the left, the signals and derails being known by the number of the lever to which they are connected. For the same reason they are painted different colors; the switch levers black, home-signal levers red and distant-signal levers green As a further aid, it is usual to group the signal levers for trains going in one direction, at one end of the machine, the signals for the opposite direction being connected to the levers at the other end, the derails and switches being connected to the remaining levers grouped in the center. It is usual in installing a plant to put in a machine having spaces for one or two levers more than the number actually needed, so that in case it is desired to connect other switches or derails, it would be a very easy matter to put in the necessary levers. These spaces are designated as "spare," the numbers left out being equally divided

1—2.
2—6, 11.
3—4.
4—7, 9.
5—SPARE
6—7.
7— FIG 6
8—SPARE
9—7.
10—9.
11—6.
12—11.

1—2, 8.
2—6, 8, 8, (9 With 8), 14.
3—4.
4—7, 12.
5—SPARE
6—7.
7—
8—6, 16.
9—6, 8.
10—SPARE
11—SPARE
12—7.
13—12.
14—8, 8, (9 With 8).
15—8, 14.
16—14.

FIG 7.



INTERLOCKING SIGNALS FOR A PLAIN CROSSING—12-LEVER FRAME.

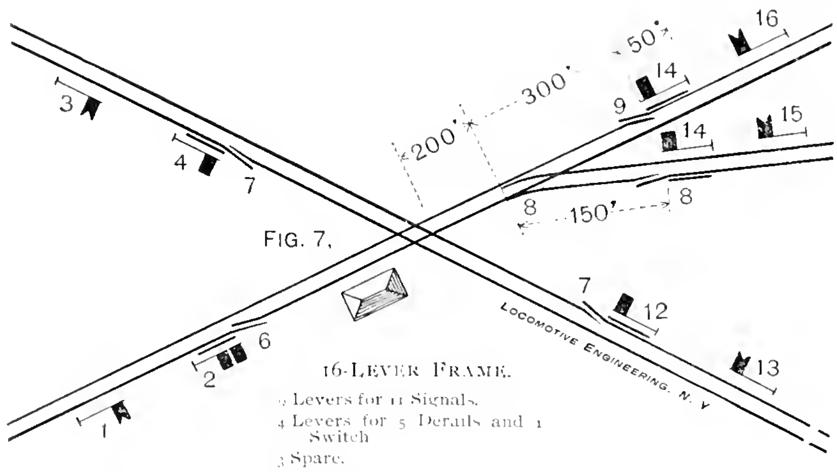
8 Levers for 8 Signals. 2 Levers for 4 Derails. 2 Spare.

on each side of the group of switch levers, thus separating the groups as much as possible. A "frame" of the machine is made to hold eight levers, but as the manufacturers furnish what is known as a "half frame," it is usual to put in a machine capable of holding the number of levers divisible by four that is next above the required number.

A plan of this crossing, as outlined, is shown in Fig. 6. By observing the numbering shown, it will be seen that only ten levers are required, as from its not being necessary at any time to close one derail without the other, it is possible to work the two derails by one lever. This will leave Nos. 5 and 8 vacant or "spare," a twelve-lever frame being the smallest size that would hold the number of levers required. If the levers working the derails and signals are now interlocked mechanically, so that it is impossible for the signalman to close the derails on but one track at a time, and to clear a signal for a train to pass over the crossing on that track in but one direction at a time, the interlocking will be complete, and it will be perfectly safe for any train for which the signals have been cleared to proceed, without reducing speed beyond that necessary in going over the crossing frogs.

The mechanical construction of the locking will be explained later on, as it will suffice for the present to say that the locking is arranged in as simple a manner as possible, each lever locking only those levers which, if pulled, would change the route indicated by the signal, or allow two trains to come together on the same track. Each lever, when reversed, is not made to lock every other lever controlling any part of the route, but only such levers as have not already been locked by some lever that is locked by the one reversed. For instance, if lever 2, when reversed, locks lever 6 reversed, and No. 1 reversed locks lever 2 reversed, there is no need of making lever 1 also lock lever 6 reversed, as one lock is sufficient to prevent the lever from being moved.

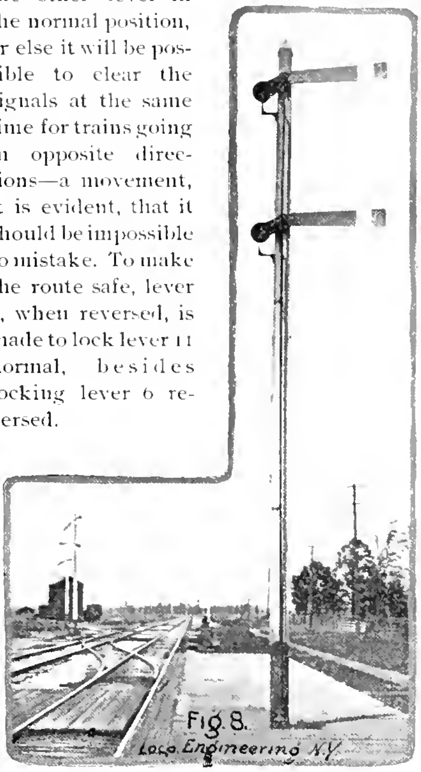
As the derails on but one track should be closed at any one time, the lever of one set, when reversed, must lock that of the other; or lever 6, when reversed, must lock lever 7 in its normal position. If lever 7 is reversed, it will be impossible to reverse lever 6, as the locking will allow of lever 6 being pulled only when lever 7 is normal. The two levers are thus interlocked, and a signalman cannot make a mistake and reverse both of them at the same time. They both can be in the normal position, but only one can be reversed at the same time. As the signals governing any route must lock the levers controlling the switches of that route, lever 2, when reversed, must



16-LEVER FRAME.

9 Levers for 11 Signals.
4 Levers for 5 Derails and 1 Switch
3 Spare.

lock lever 6 when reversed. So, also, must lever 11 lock lever 6 reversed. But as lever 2 and lever 11 are signals governing the same track, but in opposite directions, one of the levers, when reversed, must lock the other lever in the normal position, or else it will be possible to clear the signals at the same time for trains going in opposite directions—a movement, it is evident, that it should be impossible to mistake. To make the route safe, lever 2, when reversed, is made to lock lever 11 normal, besides locking lever 6 reversed.



A Two-Armed Signal Pole.

As the distant signals must never be cleared until after the home signal has been cleared, the lever of the distant signal, when reversed, must lock the lever

(1)—(2)
(2)—(7), 4.
(3)— 8, (8), (11) W 8).
(4)— 8, (8), (7) W 8).
(5)—(6). FIG 10
(6)—(10).
(7)— 8, 9, 10.
(8)— 9, 10.
(9)—
(10)—
(11)— 8, 9, 10.
(12)— SPARE
(13)—(9).
(14)—(13).
(15)—(11), 3.
(16)—(15).

of the home signal reversed, in which case all the levers for that route will be locked reversed, and all the other levers of the machine locked in the normal position. For if lever 1, when reversed, locks lever 2 reversed, then lever 6 must be reversed and lever 11 will be locked in the normal or danger position, and a train approaching from the direction of signal 1 will be the only train for which the derails are closed and the signals cleared for it to pass over the crossing.

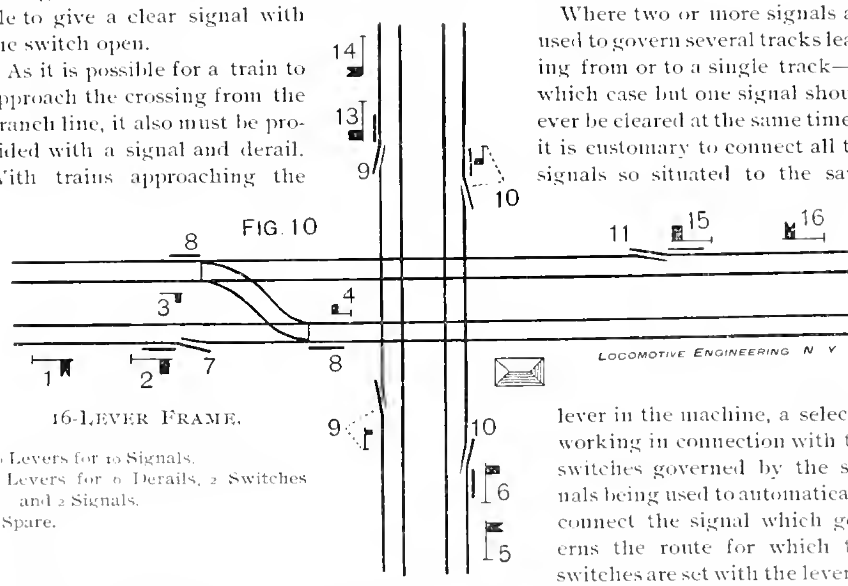
For the sake of convenience and clearness, the locking performed by each lever, when reversed, is arranged in the form of a diagram or sheet, as is shown in the figure, the circle put around the figures indicating that that lever is reversed—otherwise the lever is supposed to be in the normal or danger position.

When two double-track roads cross each other, the same number of levers can be used, the numbering and locking being the same, except that the signals, when reversed, must not lock the home signal governing trains running in the opposite direction, in the normal position, as there are two tracks, and it must therefore be possible to clear both signals at the same time.

From this it is seen that interlocking signals for the protection of a plain crossing are very simple and are easily arranged. Where switches have to be connected to levers in the machine, and signals provided to govern all the movements that will be made in using the different tracks, the locking of the levers becomes somewhat more complicated.

In Fig. 7 is shown a crossing of two single-track roads, one of them having a junction switch or branch line leading off from the main line, as shown. This switch being located less than 300 feet from the crossing, must be connected to the interlocking machine, so that the lever controlling it can be locked with the signals governing the route, or else it would be possible to give a clear signal with the switch open.

As it is possible for a train to approach the crossing from the branch line, it also must be provided with a signal and derail. With trains approaching the

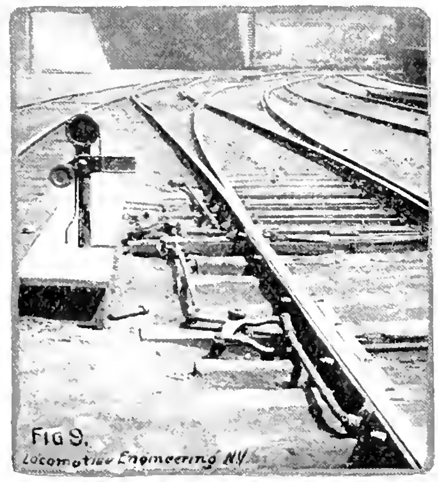


16-Lever Frame.

10 Levers for 10 Signals.
5 Levers for 6 Derails, 2 Switches and 2 Signals.
1 Spare.

crossing on the single track, two signals must also be provided, as it is necessary to indicate to the engineer which of the two possible directions his train is to take. As there should be but one signal pole for a given track, to enable the engineer to know which signal is the one governing his train, and as it is necessary in this instance to have two signals, the two are put upon the one pole, as seen in Fig. 8—the upper blade being used to govern the high-speed or main-line route; the lower, the secondary or branch line.

This, however, is not the practice on all roads, English roads being a notable exception; for instead of the upper blade being used to govern the high-speed route



A Dwarf Signal.

it is made to govern the track leading to the right or left from the switch. In this country it is the right hand, and in England the left. This practice is not to be recommended, as it requires the engineer to locate each side track and decide whether he wants the upper or lower blade, a thing which is apt to be confusing when one is traveling on an engine at a high rate of speed, and has to take the lower blade on one pole and the upper on a pole a few hundred feet beyond it.

Where two or more signals are used to govern several tracks leading from or to a single track—in which case but one signal should ever be cleared at the same time—it is customary to connect all the signals so situated to the same lever in the machine, a selector working in connection with the switches governed by the signals being used to automatically connect the signal which governs the route for which the switches are set with the lever in the tower. Practice in this regard has been carried too far, and the tendency at present is to use a separate lever for each signal, or, at any rate, never for more than two. As a separate lever for each signal is a very expensive arrangement, and as a selector for two signals can be made to work well

with a little care and attention, it would seem to be good practice to continue the use of this arrangement. Selectors for more than two signals, however, are not to be recommended.

By looking at Fig. 7 it will be seen that thirteen levers are required to work the switch, the derails and the necessary signals, and that while the switch and derail on the secondary track are worked by the same lever, the two derails on the main line are worked by separate levers. The reason for this is, that while it must not be possible to close the two derails 8 and 9 at the same time, for fear of two trains running together at the switch, it must be possible to close derail 6 on the other side of the crossing for either route—the one on the branch or the one on the main line.

The locking required to make the operation of the crossing safe, made necessary by switch 8 being connected to the machine, is also more complicated than that required for a simple crossing. By an examination of the locking sheet shown in the figure, it will be seen that, before any signal can be given to a train, the derails and switch will have to be set for the route it is to take, and that the signal governing the opposing route is also locked. For instance, lever 2 reversed locks derail 6 reversed, locks switch and derail 8 normal and reversed, because the switch is used in one or the other positions each time the signal is cleared; locks derail 9 reversed when switch 8 is normal and the route is set for the main line, and, last of all, locks lever 14 in the normal position, preventing either of the opposing signals from being cleared.

To make it impossible for both roads to use the crossing at the same time, lever 6, when reversed, is made to lock lever 7 in the normal position. As levers 8 and 9, when reversed, both lock lever 6 reversed, the reversing of any one of these will lock lever 7 in the normal position, so that the derails cannot be closed. It will be noticed that lever 8, when reversed, locks lever 6 reversed and lever 16 in the normal position, the object of locking lever 16 normal being that, as lever 14 can be reversed if either lever 8 or 9 is reversed, it would be possible, when 14 is reversed, to reverse lever 16 and clear the distant signal when the switch and derail 8 may be closed, and thus a wrong signal would be given. By this arrangement it is possible to reverse lever 16 only when lever 14 is reversed, locking derail 9 reversed, with switch 8 in the normal position.

Should switch 8 lead to a side track instead of to a branch line, the signal on side track governing the movements made from the side track to the main line would be made a dwarf or low signal, as shown in Fig. 9, and no distant signal would be provided. The object of this is to lessen the chance of an engineer mistaking the indication of the signal on the side track for the one on the main line, and also to effect a saving in the original cost of the plant. As movements on a side track have to be made at slow speed, there is no necessity for putting the signal on a high pole, where it can be seen at a distance, the low or dwarf signal answering perfectly well for this purpose.

Dwarf signals are used to control all "back-up" movements, or those made against the movement of traffic, the reasons being the same as those governing movements from side tracks.

When a cross-over between two double tracks at a crossing has been connected up, it should be signaled as shown in Fig. 10, the locking performed by each lever, when reversed, being also given. It will be noticed that back-up derails have been provided on one track, dwarf signals governing the back-up movement being connected to and moved by the same levers, so that whenever the derail is closed, the signal will indicate safety. Back-up derails are generally not provided, unless the arrangement of the tracks or the traffic is such that movements against the direction of traffic are frequently made. As the commissioners of several of the States require these to be put in at all plants under their jurisdiction, they have in such cases to be put in whether there is or is not any probability that they will ever be needed.

It is to be noticed that dwarf signal No. 9, while governing back-up movements in two directions, either on the main line or on the cross-over, is a single-blade signal, and does not indicate to trainmen the route they are to take, but only that the route is clear for them to back up. The reason for this is that in practice it has been found to be the best plan, as the movements are made slowly, and the towerman has, in any event, to know the movement it is desired to make before throwing the levers, for the matter to be left entirely in his hands for him to throw the proper switches before clearing the signal.

Again, a single-blade dwarf signal can be put in between tracks in many places where there is not room in which to put one having two blades. The saving in original cost of the plant is also quite an item, particularly if there are very many dwarf signals required.

The combinations of the levers by which the derails are closed and the signals cleared for a train to proceed over the crossing, are very simple with the plant under consideration, the derails of any one track being first closed, the home signal next, and, last of all, the distant signal. When it is desired to use the cross-over, the engineer will run by sufficiently to clear signal 4, when the towerman, putting levers 1, 2 and 6 back to normal, will reverse lever 8 and pull 4. Reversing lever 4 clears the signal, and the switch being thrown, the train is switched over to the other main line.

With plants having any more levers than those necessary to operate a simple crossing, it is necessary to provide in the tower, for the guidance of the signalman, a "combination sheet," showing the order in which the different levers should be pulled to clear the different routes. This order is made necessary by the locking of the levers, those which are free to move being first reversed, then those which are released by the reversal of the first lever, and so on, until all the signals for the route desired have been cleared.

Although it would appear to anyone a very easy matter to find out which are the proper levers to reverse to give a clear route, such is not the case, as has been shown in many instances, where, from some cause or other, it has become necessary to put new men in the tower who do not know the proper levers, or when, as in case of accident to the signalman, the trainmen have had to work the levers to let their train over the crossing.

A large size map, with the switches and derails plainly numbered, as well as a combination sheet in which the different movements are shown in large type, should be framed and hung up in every tower. The wisdom of so doing will be evident to anyone who has ever tried, unaided, to clear the signals for a train at even a small crossing.

The Pennsylvania Railroad Company are doing something in their shops at Altoona that will furnish information which will be of value to all railroads in the country. They are building three mogul compound locomotives, which will be identical in every respect except the parts which control the compound feature. The cylinders will be of the same proportions. One will have the Lindner starting valve, one will have the Richmond Locomotive Works intercepting valve, and one will be built with the Pittsburgh Locomotive Works arrangement for regulating the admission of steam in starting. It is the intention when the engines are finished to put them all into the same kind of service, and subject them to a lengthened test under conditions as nearly uniform as possible. The decision to select these types of compounds was arrived at on account of the experience with engines compounded according to the designs named.

At Sprague, Wash., the Northern Pacific lost by a fire, a few weeks ago, twenty-four locomotives, fifty-four freight cars and shops and machinery, valued at $325,000. We are informed by an officer of the company that no time will be lost in erecting new buildings and equipping them with first-class machinery.

At the last Master Mechanics' Convention, a suggestion was made to change the constitution so that the association should be representative of railroad companies instead of individual master mechanics. Proposals of this kind have been made repeatedly in past years, but the members do not take kindly to them.

Doing Machine Work Under Difficulties.

At the last meeting of the American Society of Mechanical Engineers, a paper by Mr. Robert Allison was read, which gives an interesting account of the difficult machine work done by hand in the olden time. The following are extracts from the paper:

"It is now about 51 years since I first entered a machine shop as an apprentice, in 1844, my first experience being in the shops of Haywood & Snyder, at Pottsville, Penn. The shops were considered as well equipped as any in the interior of the State; there were two or three slide lathes (not screw-cutting) in the shop, but most of the turned work was done with the slide rest, and all the small turning was done with hand tools. There was one planing machine in the shop, the table being pulled back and forth with a common one-half inch chain. I recollect that this chain would break frequently, sometimes two or three times a day, so a number of open links were kept on hand to make quick repairs. The cross-feed was automatic; all other feed directions were by hand. Those of you who have had any experience in a modern shop will appreciate the difference between those crude machines and the machines now in use.

"The work done in the shops was principally steam engines, and notwithstanding the poor facilities, many good engines were turned out, some of which are in use to-day.

"After working in the Pottsville shops about one year I was sent to Danville, to the branch shops. The shop was equipped with two large lathes, 36-inch swing, mounted on heavy wooden shears, and the turning was done with heavy slide rests; there were also three smaller lathes on wooden shears, with slide rests; and two hand lathes, operated exclusively with hand tools; also one drill press and one screw-cutting machine—this constituted the whole plant.

"Rolling mills were built in this shop, the engines being built in the Pottsville shops. In the early days of rolling mills, the engines were made long stroke, usually 6 feet, and the rolls were driven with gearing so as to get up the proper speed, the piston speed of the engines being about 300 feet, the gear wheels being large in diameter; there were no facilities for boring the hubs, and they had to be keyed on the shaft with six or eight keys. This necessitated much chipping of key seats.

"Shafts were all made of cast iron of large diameter, with bosses in proper places for wheels; the bosses were turned off, and then eight flat places were chipped and filed true for keys; the wheel hubs were cored out about 1½ inches larger than the shafts, and eight key seats cut out of proper width and taper, according to the size of the shaft; then the wheel was staked on the shaft with four short wedges on each side, leaving four of the key seats clear. It required considerable skill to get the wheels true on the shafts, and but few were able to make a good job. After the wheels were staked on true, four of the keys were fitted and driven home, the stake wedges removed, and the other four keys fitted. Large cranks were fitted to shafts in the same way. The whole operation required a great deal of skill, and unless a man was an expert chipper and filer he would make very slow progress. The turning of large shafts was slow and tedious. The writer remembers having a cast-iron shaft 10 inches in diameter and about 10 feet long, being given to him to turn on a hand lathe, with hand tools, the slide rests all being in use; the tools used being hook tools 'V' and round nose, button and spike heads. Just imagine the feelings of a machinist of the present day if confronted with a job of that kind! I also remember another job that almost made me sick. This was forty set screws, 1¾ inches in diameter, about 4 inches long; the iron was seamy and hard; they had to be turned from point to head and thread chased the whole length. You can hardly imagine the condition of mind I was in by the time I finished the last screw; and I think that if there had been about five more in the lot, the country would have been obliged to get along without my services as a machinist, as I would have quit the business in disgust.

"The chasing of screws by hand was one of the things we all had to learn. Starting the thread properly required considerable skill; drunken threads were rather common, and subjected the producers to considerable ridicule in the shop. All plane surfaces had to be chipped and filed, no matter what size, and good chippers were always in demand. Engine guides were made round, because shops had no planers to plane them if made flat, and when the first flat guides were made they had to be chipped and filed; connecting rod stubs were fitted the same way.

"Notwithstanding all these drawbacks very good work was turned out, some of which will compare favorably with the work of the present day. We still have some old fogy machinists who claim that the work of the present day does not compare with old-time work, when accuracy and finish depended on the skill of the workman rather than on the accuracy and automatic operation of modern machinists' tools. The writer has had considerable experience in old-time methods and with modern tools, and has no hesitancy in saying that the work of the present day is far superior to what was turned out by the old methods; but the wonder is how such good work was turned out with the limited appliances at hand, and the mechanics of fifty years ago deserve more credit for their productions than those of the present day.

"It may interest some of you to have a short account of how a steam engine was produced fifty years ago in the shops where the writer learned his trade. First, a large drawing board was prepared, large enough to make a plan and side elevation, full size. Engines all being made very long stroke, the drawing boards were quite large; an engine of 14-inch diameter, 48-inch stroke, taking a board about 6 x 20 feet. The engine was plotted down, lines chalked and leaded; patterns were then made to correspond to the drawings, castings were made and fitted, but connecting rod, piston rod, valve rods, etc., were left till the cylinder, guides and pillow block were fitted on the bed plate.

"Measurements were then taken for the different rods, and the rods made the proper length to fit. No two engines were exactly alike; variations in shrinkage and fitting were adjusted in the length of the rods. Generally, after the first engine was made, the drawings were planed out, so that the drawing board could be used for another size. This destroyed the record of sizes; but as all rods were measured for each particular engine, this did not interrupt the work of construction. I need not refer to the present methods in this line, as you are all familiar with them. To-day almost every part of an engine, or other machine, could be made in different shops, widely separated, and then assembled into a complete machine without a hitch. This would have been impossible under the old plan. Taking all the disadvantages into consideration, the wonder is that the mechanics of fifty years ago could turn out as good machines as they did."

Are Engineers Fatalist?

At a pic-nic of the Brotherhood of Locomotive Engineers, held at Knoxville, Tenn., Attorney-General James H. Bible delivered an address in which, while trying to be complimentary, he gave expression to a belief which we do not think will be indorsed by the average engineer. He said:

"An engineer, as a rule, ought to be a Presbyterian, for they believe that whatever is to be will be. I have talked with numbers of them, and they all tell me that there is no use to try to avoid destiny. They are fatalists in the main, and think that we must all go when our time comes, whether it be at home, surrounded by friends, or down an embankment when the stars are shining. In the minds of some people this may not make saints of them, but it does another thing, which as far as the world is concerned is better—it fortifies them against panic and surprise, and gives them thoroughly disciplined natures. Another thing it does—it reconciles them to the life they are forced to live, which is one cut off from the balance of the world—a life of isolation, so to speak."

The Traveling Engineer.

The Traveling Engineers' Association will meet in convention at Pittsburgh on September 10th. There is an excellent programme of business prepared, and the meeting promises to be of much interest and of practical value to railroad companies. The Examination of Firemen for Promotion, promulgated by a committee of the Traveling Engineers' Association last year, has excited much attention and no little criticism; but its use is steadily spreading, and the knowledge made compulsory is calculated to do much good, even to those who consider the examination too exacting.

The intelligent, systematic work done by the Traveling Engineers' Association is doing much good, not only to the members, but to the traveling engineers as a class of railroad officials. The work done by the association has spread before the higher railroad officials information concerning the valuable nature of the duties performed by traveling engineers and road foremen of engines, that required only to be known to be appreciated. There was a disposition in some quarters to regard the traveling engineer as a superfluity, to be cut off on the first call for the curtailing of operating expenses. People are slowly learning that the dispensing with the services of traveling engineers is the most certain way to increase operating expenses.

The traveling engineer is essentially a leader and teacher of the most improved methods for handling and operating locomotives. If his tendencies do not lead in that direction, his influence is not likely to be of benefit to the company. There have been, repeatedly, cases of the traveling engineer failing to prove a success; but it has generally happened owing to an injudicious choice, or through the failure to give him the necessary authority. It was formerly considered proper to promote one of the oldest engineers to the position of traveling engineer, regardless of what knowledge he might have of the locomotive and its attachments. That was the right way to keep the men moving along in the old rut, without a thought of how to do their work as well as it could be done.

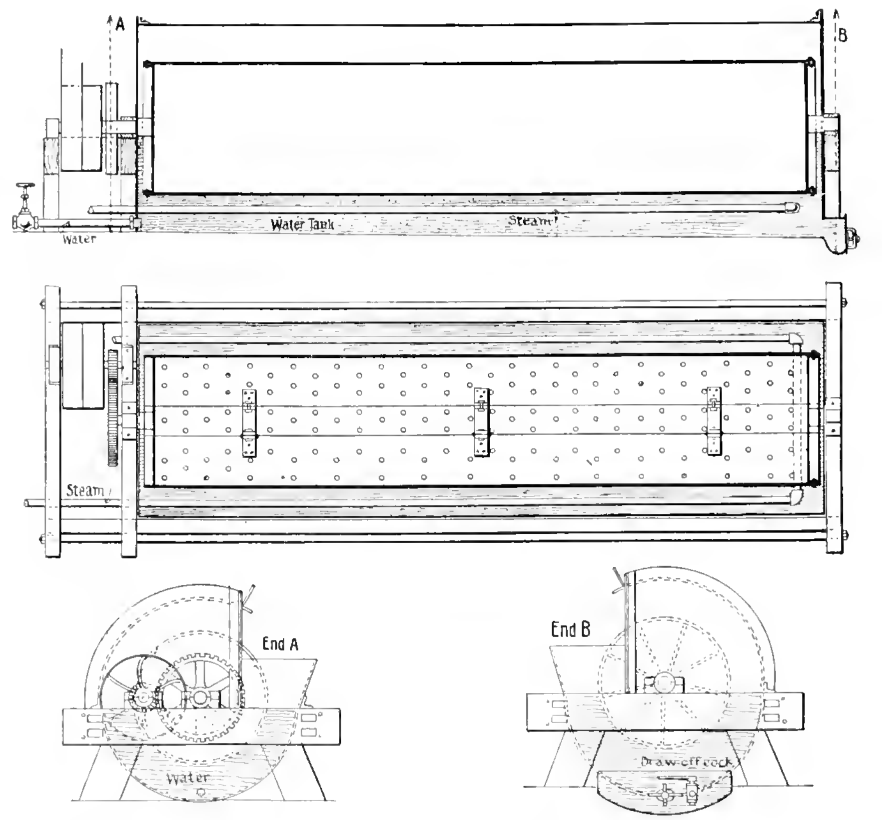
There are on every railroad enginemen of an inquiring disposition, men who want to understand the why and the wherefore of the action of the machines they handle. They study the action of steam and the phenomena of combustion. They are not content to know merely how to apply and release an air brake. They must know the principle of its action and the details of the mechanism. Men of this kind make themselves familiar with the mechanism of injectors and lubricators; and when anything goes wrong, they are liable to have a simple remedy ready. From this class the traveling engineer ought to be drawn. He is likely to be as good a runner as any other man on the road, and he has knowledge that the majority do not possess. His knowledge is capital which makes him more valuable to his employers than the average man, who merely learns enough to get along with a train. With the special knowledge he has acquired, and an ability to manage men he is certain to make a success if he is given the opportunity.

When a man of this character is chosen he should be invested with sufficient authority to make his orders and directions respected. Although master mechanics and superintendents are hard worked as a class, it is sometimes very difficult for them to give up a share of the authority they have been in the habit of exercising over the *personnel* of their department. They are particularly fond of having something to say about individual engineers and firemen, and the traveling engineer sometimes finds that he cannot discipline a worthless man because the latter has some influence with a higher officer. Where practices of this kind exist they are demoralizing to all authority. It is right and proper that every man should have the power of appeal, but that should involve a hearing where all the facts could be brought out. Where a sharp traveling engineer is employed, the worthy and competent men receive a greater share of justice than they obtain under a looser system. The traveling engineer is on the road the greater part of the time, and becomes much more familiar with the habits of the men than it is possible for a superintendent or master mechanic to acquire, since these officers rarely come in contact with the men at their work. Under the old system, a shirk who habitually neglected his work was often, by reason of a smooth tongue, the greatest favorite at headquarters. Good men nearly all agree in the sentiment that they have a friend in the traveling engineer.

A Silent Flue Rattler.

At the Erie shops in Jersey City, N. J., they employ a flue rattler, or tumbling barrel, that tends strictly to business and makes little fuss about it—like silent barbers, very rare.

Our sketch will show the arrangement. The barrel revolves in a tank of water reaching up to the shaft. The water has been found to shorten the time required to clean flues. The work is done better and more uniformly. Sketch shows framing, tank and draw-off cock for water, and



also a steam pipe used in winter to prevent freezing.

If there is any one thing that sets the teeth on edge around a shop, it's the everlasting rattler with its everlasting rattle. Some master mechanics have put it in a cell and locked the door, others have buried it in a pit, and still others have exiled it to the farthest corner; but its voice, like the wail of a lost soul, reaches to the four corners of the place. If water is the cure, tap a river at once.

The Webb compound locomotive purchased by the Pennsylvania Railroad in 1889 is now employed hauling a gravel train. The engine has some good points, but they do not appeal directly to men employed on gravel trains. She is not considered a success for that kind of train service.

Comparing Experiences.

After going over the Jaffa & Jerusalem Railroad, which is famous for the picturesque roughness of its track, Cy Warman was moved to remark, "I traveled over a little lumber road in Texas once, whose initials were T. & S., and the trainmen called it the 'Trouble & Sorrow,' and sometimes 'Timber & Sand.' I rode on the locomotive, for it was the first wood burner I had ever seen. The train was carded at twelve miles an hour, and we were losing time, but it was the only time I was ever frightened on an engine. The road was so rough and the engine rolled so, that the hazel-splitter hogs would scamper out of the ditches beside the track. In places the track was so sunken that the ties hung to the underside of the rail, and when the engine struck a place like that, and drove the ties down, the mud and water would shoot out over the face of the earth and fresco everything inside the right of way. The passengers, if they had not been too frightened, could have picked flowers from the windows of the rolling coaches, almost. Till now the T. & S. had been to me the rockiest road on earth; but now it's all changed.

Now the whistle sounds, deep and long; the train has reached the top of the cañon—the end of the gulch—and here before us, nestled in the very top of a group of little hills, is Jerusalem. The sun is just going down in the hills through which we came, and away to the east, beyond the Dead Sea, the hills of Moab are taking on the wonderful tints they wear at sunset. They are unlike any other mountains, in that the crest-line is as straight as the line of the horizon on a level plain.

How strange it all seems! There is nothing but rocks and scrubby olive trees, and dead-looking grape vines, and not many of them. The people are strange, too. On the way to the hotel we pass all kinds of people of the Orient. Bedouins, with their knees cocked up, on high horses; plainsmen on thin-legged Arabian steeds; all manner of men on donkeys and on foot, beggars and even lepers, and poor Jews; Jews with corkscrew curls hanging down in front of their ears, and idle pilgrims who do nothing on earth but walk all day long up the Valley of Jehosaphat and down the road to Bethlehem. They come, many of them, from Russia. They have nothing when they strike the town, and just about manage to hold their own."

The Gibbs Variable-Speed Electric Motor.

The annexed illustrations show a variable-speed, back-geared electric motor, made for the Illinois Central Railroad shops by the Gibbs Electric Company, Milwaukee, Wis. Electric motors are coming steadily into use for driving machine tools, portable drills, and a variety of purposes in boiler shops. This type of motor is reported to be exceptionally efficient and convenient for railroad work, being designed by railroad mechanics.

Fig. 1 shows the motor ready for work, with the pulley at the commutator end, ready for the connecting belt. Fig. 2

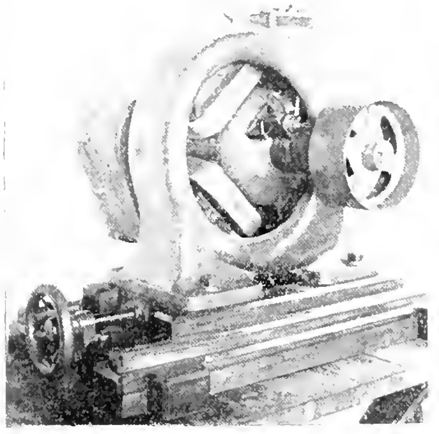


FIG. 1.

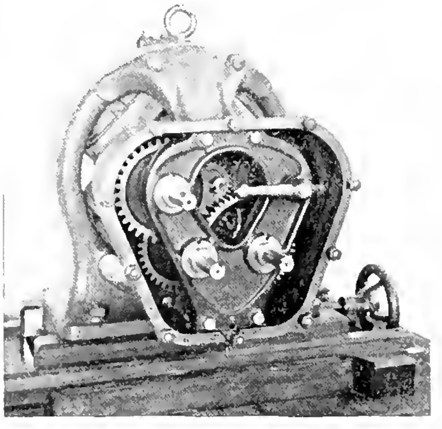


FIG. 2.

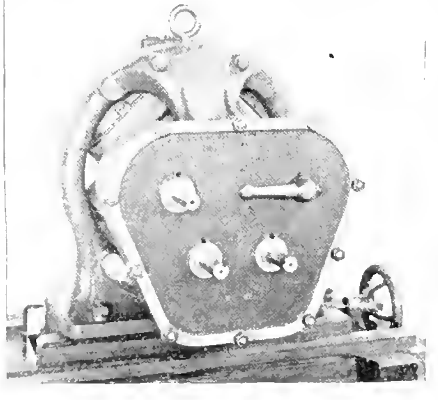


FIG. 3.

shows the back gears exposed. These are provided to give the motor changes of speed, similar to the arrangement of back gears of an engine lathe. By this means changes of speed, with a range from 38 to 850 revolutions per minute, can be had.

Fig. 3 gives an opposite view from Fig. 1, with the gears covered up. Connection with a flexible shaft for drilling, tapping, or other work, is made with the spindles shown in this view. The handle shown is for changing the speed.

The case is filled with oil for lubrication up to the first row of spindles, but the casing can be left off if preferred.

Cutting the Requisition in Two.

There are certain high-up railroad officials who make it their duty to supervise the requisitions for supplies and material, which is not done wisely, but too well. Good sense and business sagacity would suggest that if the head of a department could not be depended upon to order only what was absolutely necessary, the best thing would be to find one who could do the duties without constant meddling supervision from some impracticable vice-president, who knows nothing about the business and is inspired only by a spirit of parsimonious cheese-paring. Railroad men were laughing about a case which was made public, where a belt 100 feet long was ordered for a railroad company's elevator. Nothing shorter was of any use, but the zealous V. P. got in his blue pencil and cut the requisition in two.

We have just heard of a similar case that happened a month or two ago. An engine had been in a collision and got both cylinders smashed. The master mechanic put in a requisition for two new cylinders from the builders. The V. P. got in his work and made it one cylinder. The engine was sorely needed, and the cylinders were waited for with impatience. Everything was got ready to put them on as soon as they arrived. Imagine the consternation of the men hungering for the service of the engine when one cylinder came instead of two, and they had to wait a month longer before another could be received. Verily, blue tape and blue pencils are making dreaded inroads upon the common-sense methods that used to prevail in railroad business.

Some years ago the principal street railroad companies in Brooklyn got permission to adopt the trolley system. It was no sooner in running order than the cars were run at a very high rate of speed, in order to draw business away from the elevated railroads. The most conspicuous result of the high street-car speed was the killing of over 100 persons in three years. This roused public sentiment so that city ordinances were passed reducing the street-car speed to six miles an hour in the more crowded parts of the city, and to eight miles in the more thinly used streets. Since that change was made, the slaughter of the innocents has ceased. Now the railroad companies have applied to the courts to overrule the city ordinances, and permit them to resume the dangerous speed.

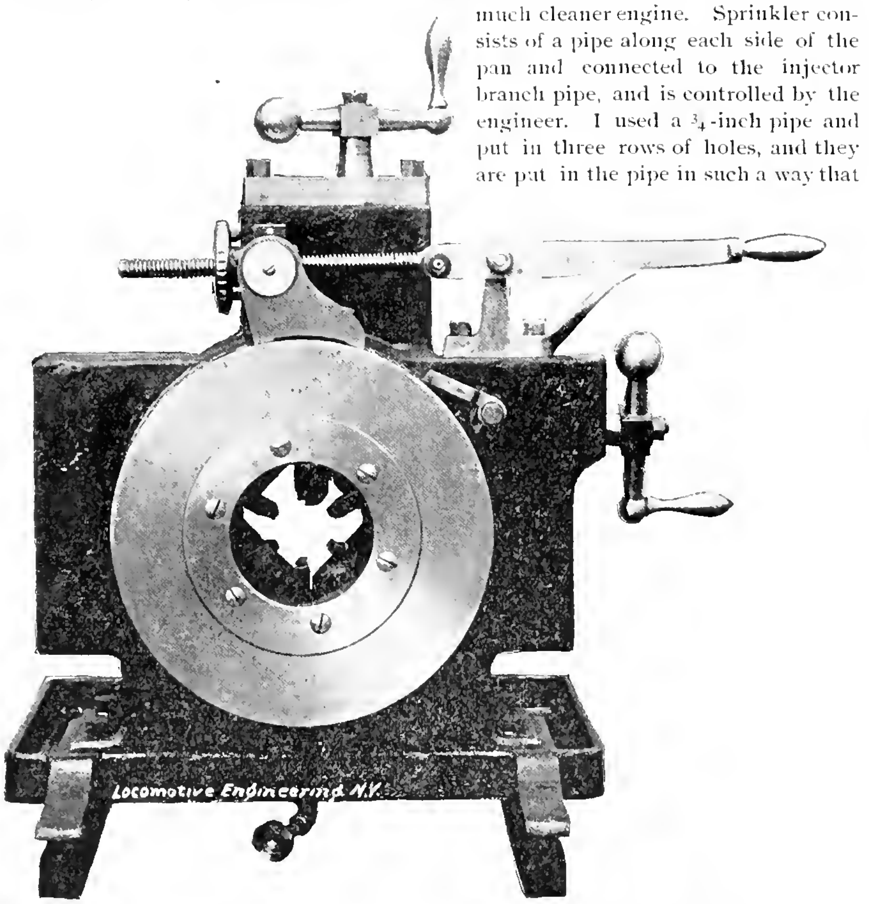
Improved Die for Pipe-Threading Machine.

Our illustration shows the die head of a Peerless pipe threader, made by the Bignall & Keeler Mfg. Co., of St. Louis, Mo.

This die is the neatest, easiest operated one we have yet seen for cutting pipe threads, practically duplicates of each other.

The body of the die, the frame, has around its center heavy slots carrying the cutters; over these fits a cam ring, having a slot for each cutter and holding their cutting ends rigidly at a given distance from the center.

Revolving the ring in one direction



opens the dies and in another closes them.

The position of the cutting ends is fixed by a hand nut—shown on the linked rod attached to lever—no other adjustment of the machine can change this, which, it will be seen, governs the size of the thread to be cut.

To cut uniform threads on a lot of pipe, it is only necessary to adjust this nut once, and leave it alone. The pipe is revolved by a chuck on another part of the machine, the threads cut, and the operator lifts the lever shown; this revolves the cam ring, opens the cutters and releases the pipe. When the lever is lowered the cutters return to exactly the same position as before and are ready to duplicate their work.

It will be seen, also, that the adjustment of this nut is an easy way to thread odd sizes.

An Ashpan Sprinkler.

We have received from Mr. R. G. Ramsay, Davenport, Ia., sketch and description of an ashpan sprinkler used for wetting down the ashes in the pans. He had put the device on some engines belonging to the Great Northern and found it highly satisfactory. He writes: "Its uses are, first, to prevent the raising of fire along the track and on bridges; second, to keep the ashpan cool and prevent the heating of driving boxes, also to prevent the pans from warping out of shape with the heat; third, to prevent the ashes from flying on the machinery, saving one-half of the wiping and helping the fireman to keep a much cleaner engine. Sprinkler consists of a pipe along each side of the pan and connected to the injector branch pipe, and is controlled by the engineer. I used a $\frac{3}{4}$-inch pipe and put in three rows of holes, and they are put in the pipe in such a way that all the surface of the pan is sprinkled. The holes are $\frac{1}{32}$ inch, 2-inch pitch, and are punched in the pipe. This leaves a burr on the inside of the pipe that causes a perfect spray; but I found in time the ashes would settle in the pipe and cause a cement, which, in time, would close up the holes. To prevent this I ran the pipe out of the front end of the pan, and put a plug in that could be removed and the pipe blown out once a week. The expense of putting this on is about $4, material and labor."

Certain old employés of the Pennsylvania Central and State & Portage roads are working up a reunion of the employés still alive, to be held at Altoona, Pa., next month. Anyone interested can obtain particulars by applying to W. de Sanno, Panhandle shops, Indianapolis, Ind.

Questions Suitable for Answer.

Nearly every month we receive letters asking us to send correspondents particulars of all the patents taken out for certain devices. The last application of this kind was for us to send private information, or publish in our "What You Want to Know" columns, information concerning all the patents secured on injectors. Those at all familiar with the history of that instrument are aware that the patents covering various designs are legion. We have no time to make researches of this character. Information of any value concerning patents issued can be obtained only by a careful search through Patent Office records. There are men who make a business of doing this kind of work, and they should be consulted by people wanting such information. They can be reached through any patent attorney. The work must be paid for, but the charges are reasonable.

Those who request us to make the "What You Want to Know" columns a channel of information about patent matters mistake the purpose of that department of our journal. A question must relate to a subject in which the general reader is interested to make it suitable to receive an answer. We frequently answer questions by letter because they are not of general interest, and we sometimes advise correspondents to employ a mechanical or other expert to work out problems or designs which they suppose the editors of an engineering paper likely to furnish gratis.

When it is necessary for us to spend more than two hours in securing the facts called for by questions, we recommend them to be sent to a specialist. Occasionally we deviate from this rule, and permit questions to haunt our waking and sleeping hours for days, but the subject must be exceptionally valuable, and the weather must be more conducive to meditation than it has been this summer.

But questions about patents are for others to answer. Another subject which we reject are questions upon the merits of goods made by different manufacturers. It is hardly fair to ask us to give public evidence of the fact that Brown makes a better car coupler than Smith. Our opinion might cause useless heartburning were we to publish it.

Another question involving odious comparisons, which we must avoid, is stating our opinion on the relative merits of prominent railroad officials. It is strange that questions of this character should be sent to us, but they are. There is a curious tendency among many people to make the editor of their favorite paper a father confessor. A question which merely calls for an opinion is not adapted for our columns. We do not want opinions from our correspondents; we want facts clearly stated, and, if necessary, illustrated by good drawings. As far as possible, we reciprocate this policy.

A New Rival of the Locomotive.

The French people seem to be taking the lead in the invention of light, common road vehicles driven by power at small expense. In the neighborhood of Paris a very common thing is to see an enlarged form of bicycle driven by a small gasoline engine.

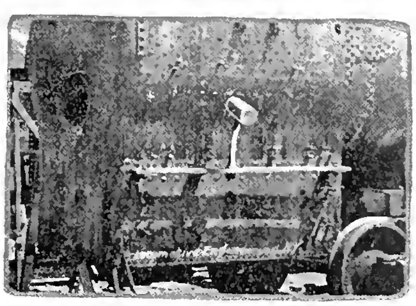
In connection with this movement highly interesting trials of self-propelling vehicles were made recently. A public competition was arranged for vehicles to run from Paris to Bordeaux and back, a total distance of about 730 miles. Twenty-two vehicles started in the race; twelve arrived at Bordeaux before the end of the time limited, and nine made the return trip successfully. These were all light, four-wheel carriages. One was propelled by a steam engine, the others were operated by gasoline motors. One of the carriages made the entire journey in 48 hours 48 minutes—an average speed of nearly 15 miles an hour, including the time lost by stops.

It was said that only about 15 ounces of gasoline per hour was required per horse-power developed. The gasoline motor is ahead of anything that has ever been tried for supplying power to light motors, for there is no furnace, no boiler and no water to carry.

French writers say that the gasoline voiture will soon, in a great measure, take the place of horse-drawn carriages on common roads, and there is reason to believe that this prediction is well founded. There is already a sort of craze in France for this kind of vehicle, and it will not be long in spreading to America. Three horse-power would probably keep the carriage going at 15 miles per hour. At this rate 10 pounds of gasoline would propel the machine 100 miles. Improvements will be made that will enable the ordinary citizen to start off on a summer outing with his wife and family in one of these vehicles, which will take him whither he pleases at small expense. That being accomplished, our inventors will proceed to make gasoline carriages to take the place of locomotives.

An Improved Helper.

Foreman Boilermaker M. O'Connor, of the F. E. & M. V. at Missouri Valley, Iowa, has constructed a simple device for hold-



ing against wedge bar while riveting on half side sheets in fireboxes. It is simple in its make up and does very good work, taking the place of an extra helper. It is placed on outside of firebox shell opposite the rivets that are being driven on the inside, and, by means of the slotted bar, it can be moved along the line of rivet holes by the rivet boy, using a wooden maul to drive it along. By keeping the iron hammer on outside end of rivet makes it very solid driving, as the steel spring handle allows it to bound back and forth as the boilermaker strikes the rivet. It is much better than a man holding, as it is stronger and its strength more uniform. It is composed of a bar of iron, 1x4-inch, with a $1\frac{3}{16}$ slot lengthways, and handle made of steel, forged down in middle to give it spring. The hammer part is a piece of axle $4\frac{1}{4}$ x 9 inches, tapered off at end, and spring-steel angle irons slotted to bolt on through stay-bolt holes at each end of long bar, the handle part that rests on slotted bar having a shoulder $2\frac{1}{4}$ inches square, and a flange cap resting on top of bar, to keep slot from spreading, the part projecting through slot being $\frac{3}{4}$ x $2\frac{1}{4}$ inches, fastened by a steel key underneath bar, as shown in our engraving.

Car Mileage.

With the increase of freight business, we already hear notes of the demand that the motive power department accelerate the speed of freight trains, in order that cars may be returned more promptly for reloading. This is a demand that became tiresome before the period of depression came on which left the car supply greater than the demand. It is part of a tendency prevailing among railroad men to place the burden of extra work upon the motive-power department. Car mileage is certainly ridiculously small, but it is not on account of trains running too slow, but because the cars stand too long in side tracks. We have heard the statement made that it takes the average freight car a longer time to pass through the Buffalo yards than it takes to go from Chicago to Buffalo. It certainly takes most cars longer to get through the yards at the end of a division than it took them to get over the division. This is the real point in need of radical reform. Direct more attention to the points where cars spend most of their time in the course of a journey, and there will be no demand for faster freight-train speed.

A BIG FOUR SPECIAL.

Inspection Engine, Big Four Road.

Our engraving was made from a photograph of a neat little inspection engine and car used by Supt. Wm. Gibson, of the C. & S. division of the Big Four.

It was built by Master Mechanic J. H. Keegan, at Delaware, O.; has two cylinders, 4 x 7 inches; uses only one ton of coal for 200 miles' run, and maintains a speed of twenty-eight miles an hour, carrying twelve people.

She is voted as "handy as a pocket in a shirt."

Notices have been issued by Vice-President St. John, of the Seaboard Air Line, that for purposes of increased efficiency in the service, and to the intent that a more direct responsibility shall attach to those in charge for the proper conduct of business to be transacted, and in order that due attention may be given to the necessities, as well as the economies of the properties, the system will be divided into three divisions, each being in charge of a superintendent, who will be responsible for the efficient operating of his division. The duties of the superintendents and other officers are defined so clearly that there will be no likelihood of conflict of authority.

Novel Air-Jet Sanding Device.

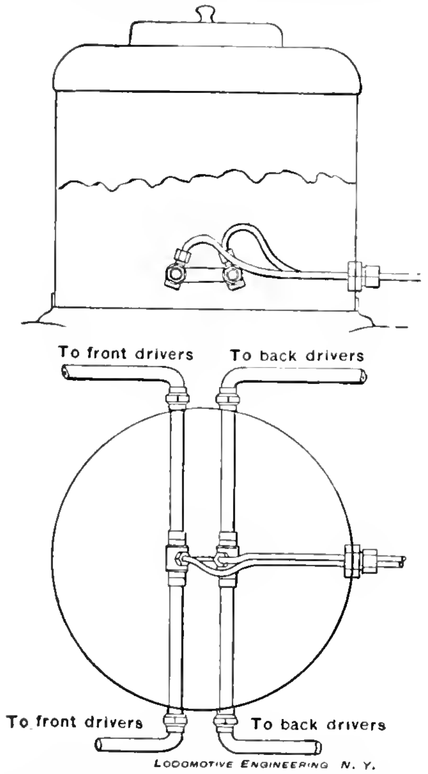
We are indebted to Mr. J. R. Groves, superintendent of rolling stock, St. L. & S. F. Railroad, for blueprints and description of the Houston sanding device, herewith illustrated.

As will be seen, the device is double; that is, made to sand ahead or behind the drivers, using separate sand pipes and jets.

The manner of piping can be seen in the engravings; the larger pipes are for sand, the smaller ones for air.

The starting valve is also shown. It is a disk valve, and the position of its ports determines where and when the sand will be sent; $\frac{3}{4}$ pipe is used for sand.

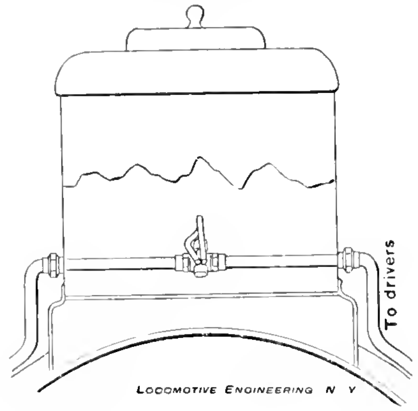
Mr. Groves writes: "We have had this device in use on some of our air-brake engines, and we are pleased to say that the service is satisfactory in every respect.

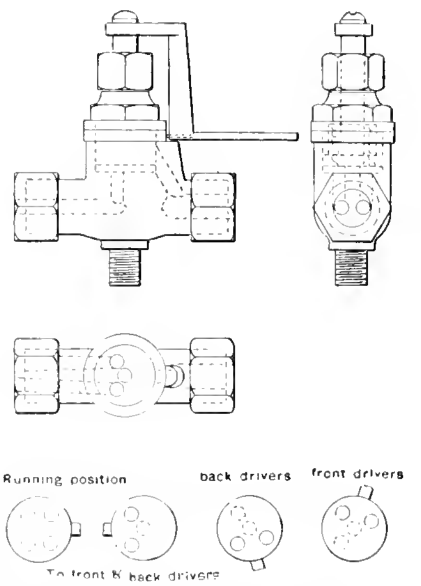


We not only get the sand where we want it, but we do not get any more than we want. The action is positive, the manipulation is easy, and the amount of sand saved in three months' time will more than offset the cost of the machine."

Chesapeake & Ohio Shops at Clifton Forge, Va.

Away near the summit or "divide" of the Alleghany Mountains, in the picturesque region traversed by the Chesapeake & Ohio Railway, we find Clifton Forge, a small, neat town, that once had aspirations of becoming a great metallurgical city which might rival Pittsburgh. The hopes were founded on rich deposits of iron ore which abound in the neighborhood, and to the fact that fuel and all other elements required in iron-making are near at hand. The town is old, dating back from ante-revolutionary times, but its modern aspect dates from the great Southern boom of ten years ago, which was suddenly to make so many wildernesses bloom with rolling mills, foundries, machine shops, and other originators of human comfort and prosperity. The boom was premature, but it left Clifton Forge with well-graded streets where rocks and brush had formerly held undisputed possession; it left a fine hotel, which offers ideal quarters for people looking for a comfortable place to spend the hot months of summer; and better than all, it left the place the fine division repair



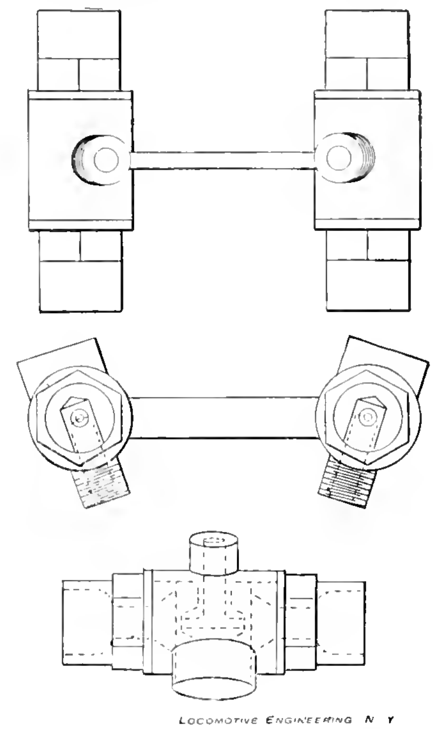


shops of the Chesapeake & Ohio Railway, which give employment to a large number of men.

The shops are substantial brick buildings, built on a meadow beside the James River, and set at right angles to the main track. The division repairs for both locomotives and cars are done here, and the shops are provided with good tools for executing the work. Mr. John A. Quinn, master mechanic in charge, is inspired by progressive ideas of shop management, and his efforts in this direction are cordially supported by Mr. A. G. Elvin, the general foreman.

In an out-of-the-way place like Clifton Forge one generally expects to find ancient tools and ancient practices holding sway, and giving entire satisfaction; but this establishment is an exception. In every quarter about the shops we find traces of individual ingenuity displayed in producing improved means of doing work. A great many operations are aided by compressed air appliances, and all lifting is done by these useful labor-saving devices. Above the driving-wheel lathe is an improvement on any air lift I had previously seen. The lifting cylinder is hung from a small overhead trolley, which is traversed over the lathe by means of a horizontal cylinder made of a piece of 3-inch pipe. A pair of wheels are brought up to the lathe on the track; they are lifted by the air hoist and traversed to their place in the lathe by the overhead trolley. A couple of men can do the job almost as quickly as the description can be read.

They have a very neat tool-room, equipped with a good supply of small tools.



Here I find a number of very ingeniously made box cutters, for finishing at one operation a variety of brass fittings. The condition of the tool-room is a significant indication of how a shop is run. This one is clean and in good order; there is a place for everything, and everything is in its place.

Very cheering news which I heard during a brief visit to these shops was that orders had been given to materially increase the number of men engaged on repair work.

A. S.

According to an Associated Press dispatch from Cincinnati, a very surprising accident happened on the Big Four line. The dispatch said that the train was running very rapidly when a piston rod broke in two about midway, the drawbar dropping and catching in the ties, pitching all the cars off the track, and altogether demolishing eleven of them.

LOCOMOTIVE ENGINEERING

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The Existing Status of the Compound Locomotive.

When the Railway Master Mechanics' Convention was held at Old Point Comfort, in 1890, the first report ever submitted to this association relating to Compound Locomotives was read, and the first discussion on the subject heard in that association was carried on. For several years previously the railroad and engineering press had been educating railroad men to make the departure of ascertaining by trial of that class of engine what there was in compound locomotives, but railroad men and locomotive builders alike were very reluctant to introduce a new type of engine. There had been a few tentative attempts to introduce compound locomotives or motors, years previously, with results that deserved further effort in that direction, but the conservative tendencies of our railroad men kept them from following up a promising line of fuel saving that ought not to have been neglected.

When the committee reported in June, 1890, the statement was made that the experience with compound locomotives in America had been so slight that the investigators were obliged to go abroad for notes of experience. There were then between six and seven hundred compound locomotives in service abroad, but only one in America, and that was a Webb compound purchased by the Pennsylvania Railroad Company. Before that year ended, however, there were compound locomotives running, or in course of construction by the Schenectady Locomotive Works, the Baldwin Locomotive Works, the Rhode Island Locomotive Works, and the Chicago, Burlington & Quincy Railroad. Although they displayed extraordinary reluctance in making the first trial with compound locomotives, American railroad men took to that style of engine very readily after the first of home manufacture was put to work. Two years after the first of our present compounds was built there were 114 running on different roads, and a year later the number was 422. That was in 1892, and the number of these engines has gone on steadily increasing, but not with the rapidity that characterized the second year of the compound's introduction. There was a tendency for a time to order compound locomotives—as extension fronts were adopted on some roads—because it was the fashion; but the point was soon reached when no compounds were ordered except through the conviction that they would prove a paying investment.

For the first two years the compound locomotive was to a great extent an experiment, and the most valuable service its use performed was educating people concerning its strong and weak points. After the sentiment of wanting to be in the fashion by having some compound locomotives subsided, a period of apathy set in which has not yet passed. Extravagant expectations were excited of the great saving of fuel which could be effected by use of the compound. These expectations not being realized, there has been a tendency in some quarters to look upon this form of engine as a fraud. Jumping at a conclusion of this kind, is just as foolish and more prejudicial to the interests of railroad companies, than was the assumed expectation that such an engine would save from 40 to 50 per cent. of the fuel required by simple engines.

The subject of compound locomotives has been earnestly discussed at every Master Mechanics' Convention since 1890, and every discussion has added valuable facts to the literature of the subject. One of the most striking things connected with these discussions is, the necessity for those interested to investigate for themselves. The question has such an important bearing upon the expenses of railroad operating, that every man in charge of locomotives ought to feel it his duty to find out for himself, how a compound compares with a simple engine in the consumption of fuel and in the cost of repairs. Those who have fallen into the later fashion of sneering at the question of compound locomotives, and pretending that it is not worth looking into, are not acting for their own best interests or for the best interests of those they serve.

The Pennsylvania Railroad Company, which is noted for the excellence of its test department, has built and purchased several compound locomotives. It may be fairly presumed that the responsible officers of this company are well informed of how the performance of the compounds compares with that of the simple engines, on a railroad noted for the low price of fuel. It may then be considered of importance to learn that the Pennsylvania Railroad people are now building three new compounds, to see which of them will give the most satisfactory service. The past experience has been drawn upon as beacons to guard against mistakes; but there has been no hesitancy in showing by this experiment that there is perfect faith in the compound being an economical engine even where coal is cheap. This ought to be an impressive lesson to the mechanical officers of railroads where coal is expensive.

Serious mistakes have been made in the designing and building of compound locomotives, which are now militating against the popularity of this advance in motive-power efficiency. Designers supposed that all that was necessary to make an efficient compound was to arrange for the dimensions of cylinders and distribution of steam in the same, which would be the power equivalent to that developed by the cylinders of a simple engine of the same class. There were new strains developed which were not anticipated, and breakages of frames and of moving parts resulted, which brought the engines into disrepute among those who were not prepared to take a comprehensive view of the situation. Starting gear and intercepting valves were introduced that did not produce satisfactory results, and the inconvenience resulting was charged against the compound principle. The mistakes are slowly bringing about the required remedies. Reciprocating parts are being lightened, the weak parts are being strengthened, and improved methods of distributing the steam in starting are slowly coming into use. This is a course of evolution which will soon make the compound as free from breakage as a well-designed simple engine. The real trouble with the compound locomotive is that it came into use too rapidly.

The economy of fuel has fallen considerably short of 40 per cent., but it is still sufficient to justify all railroad companies to change their simple freight engines into compounds. That is the latest and most conservative testimony concerning the compounds which are now in use. Those who are most opposed to this style of engine and are familiar with its performance in freight service, admit that the fuel saving in freight service ranges from 10 to 20 per cent. An admitted average of 15 per cent. is not, in some quarters, considered worth having. Let us put in figures what that means. An ordinary freight engine uses six tons of coal in a run of 100 miles, the average price being $2.50 a ton. A saving of 15 per cent. saves $2.25 per trip. That saving equals the cost of repairs of locomotives on some roads.

When compound locomotives were first introduced, there was a general belief that

they would cost more for repairs than simple engines. The breakage from faulty designs has kept the average repairs higher than that of simple engines, but the repairs to boilers have been decidedly less. As the rotative effort of a compound locomotive is more uniform than that of a simple engine, the wear on the motion and running gear ought to be less, and the call for repairs will, no doubt, be smaller with more perfected engines. This leads us to expect that the reduced expense of repairs for boilers will be accompanied by reduced cost of maintaining the working mechanism. These facts, considered along with the reduced expenditure of fuel, justifies the conclusion that the man who persists in refusing to hear any good about compound locomotives is not wise in his generation.

Racing From London to Scotland.

Our barbarous practice of rate cutting is almost unknown to British railways; but every few years the competitive spirit leads the railway managers on the other side to make a bid for business on account of fast running. A competition has been going on between the rival railways running from London to the North of Scotland, which has taken away from our Empire State Express the distinction of being the fastest train in the world for a long run.

There are two rival routes from London to Aberdeen. One is the West Coast route, formed by the London & Northwestern and the Caledonian; the other is the East Coast route, formed by the Great Northern, the Northeastern, and the North British railways. The latter route goes over the Forth and the Tay bridges, which give a direct, almost straight line to the northeast of Scotland, making the distance to Aberdeen 523 miles. The West Coast route is more circuitous and covers 540 miles. The city of Aberdeen is the distributing point for the northern highlands of Scotland; is a short distance from the Queen's summer residence, Balmoral, and a vast volume of tourist travel makes that the objective point. Hence the desire of the railway companies to appear the fastest route to that point.

In 1887 there was a protracted struggle between the companies forming the rival routes to beat each other in the running time to Edinburgh, a distance of about 400 miles, the run having been achieved at an average speed of 58 miles an hour, including stoppages. This high speed was not long kept up. The pace was too great, and the rivals came to an agreement to settle down into moderate speed. But the racing showed what could be done, and it had the effect of permanently shortening the time of leading trains between London and Scotland.

Toward the beginning of July the managers of both routes made slashing reductions in the time schedule between London and Aberdeen. Before the contest began the time occupied in running from London to Aberdeen was about 11 hours, which called for a running speed of about 50 miles an hour, including stops. The East Coast people started out by shortening the time 20 minutes, and the West Coast followed by taking 40 minutes off their schedule. Then the other side made another reduction of time, and so it went on, week after week, till on August 22d the London & Northwestern train made the whole distance of 540 miles in 8 hours and 55 minutes, or 535 minutes. The Great Northern train did a little better, and completed the journey of 523 miles in 8 hours and 40 minutes, or 520 minutes. This running the protracted distance at a velocity under a mile a minute, and including the time lost in stoppages, is a tremendous achievement.

The race was continued till August 23d, when the West Coast line won the final honors, but only after it had twice been beaten by its East Coast rival. The winning score was 540 miles in 512 minutes, with an average speed of sixty-three miles an hour and a maximum of seventy-four miles an hour over a portion of the course.

The East Coast record, over a course seventeen miles shorter, was a maximum speed of nearly sixty-seven miles. Both lines have suspended racing for the season, although excited engineers, have boasted that eighty or a hundred miles an hour could be made safely. The utility of the performance is doubtful, since the lines were cleared fifteen minutes before the arrival of the flying expresses at any point, the night traffic for freight was abandoned, and the danger of the service was so great that Sir Wilfred Lawson humorously warned the directors that they were incurring liability for manslaughter. The record was made by running trains from London to Carlisle without a stop, and by reaching Aberdeen at half-past four in the morning, a most inconvenient hour.

There is an impression among many people in this country that British railways are practically level and straight. That is a mistake. The railways forming both coast routes to Scotland have long, steep gradients, and there are numerous sharp curves. Both trains had to change engines twice (except on the last day, when only one stop was made), and each had five or six stoppages. The last forty miles is run by the competing lines on the same track and there is hardly a straight or level mile on it. When all the drawbacks are taken into consideration, it seems to us that on the favorable stretches the running speed maintained must have been over eighty miles an hour. It is the most wonderful case of train racing the world has ever seen, and far transcends the performance of the New York Central train which ran from New York to Buffalo, 440 miles, in 439 minutes. The New York Central engine pulled about the same train handled by the British racing engines, but it did not have the physical difficulties to overcome that are encountered in Scotland.

The Baldwin-Westinghouse Combination.

Early last month the announcement was made that a combination had been entered into by the Baldwin Locomotive Works and the Westinghouse Electric Company for the purpose of building electric locomotives for surface railroads. This is a season of the year when the editor of the average daily newspaper finds it difficult to select from current events the subjects for editorials, and, therefore, the Baldwin-Westinghouse combine received extraordinary attention, and a flood of printer's ink was wasted upon it. The average newspaper writer does not know anything about the power problems involved in the moving of railroad trains, and all electrical phenomena are to him tiresome mysteries beyond lay comprehension. But he sees the trolley cars moved by the electric current, and it seems rational enough that all surface railroad trains should be operated in the same manner. Therefore, when the press dispatches announced that some sort of a combination had been effected between the largest locomotive building company in the world and one of the largest manufacturers of electrical apparatus, it was immediately assumed that the steam locomotive must go, and stand not on the order of its going. All sorts of absurd statements were published about the changes which the combination was immediately to make on railroad motive power, and the impression was conveyed that within a very few years a steam locomotive would be a curiosity of a crude age of motive power.

The facts are that the combination does not expect to exert any influence in urging forward the use of electric motors as substitutes for steam locomotives, but merely to employ the good facilities possessed by the two companies for the building of electric motors when they are called for. The Westinghouse Company will design and build the electric apparatus, and the Baldwin people the running gear and its connections. The slim, badly-designed running gear of many electric motors in use indicates that the facilities of concerns accustomed to the building of steam locomotives are required to produce durable electric motors for elevated and suburban service. There is every indication that new city and suburban railroads will be operated by electricity, and this is the field that the combination expects to provide with machinery adapted to the requirements.

Vice-President W. H. Baldwin, Jr., of the Southern Railway, has directed all heads of departments to transfer or discharge all men under them related to themselves by blood or marriage. This will prevent lots of cousin, nephew and brother business, and while it may work some hardships, on the whole it is for the good of the service.

Our Colored Insert.

We present with this issue the colored picture of the ten-wheeler promised early in the year.

This picture was made directly from a photograph and color chart of one of two locomotives, painted exactly in these colors, that pull the limited trains of the Erie road in and out of New York.

This picture deserves a frame, and we have no doubt at all that a large proportion of the 25,000 printed will receive them.

It may interest our readers to know that this picture was made by a new process. An invention in photography has recently been perfected whereby a colored picture can be set up and any one color on it photographed, leaving all other colors; thus: We photograph for the red, and make a plate of that photograph; then for the blue, and make a plate of that; and so on through all the colors. It follows that these photographs and their plates must be the same size exactly, and it only remains to run the plates through the press for each color, and a perfect whole is obtained. It's expensive, but—the boys must have it.

When Locomotive Engineering began making engravings of everything worth telling about, many of our competitors accused us of becoming a picture book. The march of improvements is in the line of graphics, however—if such a word may be employed. People want to know about things at a glance. We predicted two years ago that the coming trade paper would have more engravings than type in it, and still believe that that prophecy will be more than fulfilled. In another column we note the appearance of two fine catalogues of machinery from the best houses in their line, without type descriptions of the tools illustrated. These are leaders. Note to what extent this practice, this policy, will be followed. A fine picture of a machine or a tool is a description to the mechanic; sizes, weights, etc., may go into type. In the meantime, Locomotive Engineering is preparing still better things in the engraving line.

One of our friends, who is superintendent of a large railroad machine shop, took what to us is a unique plan of making the workmen familiar with Locomotive Engineering. Thinking that it was for the interest of his company that the workmen should be familiar with the literature of their business, he asked us to send him some specimen copies. These he put in the tool room and checked them out to the men. When a man had read the paper he returned it, and it was ready for the next man. By this means a few copies were used to do missionary work for one of the largest shops in the country.

The Pittsburgh, Cincinnati, Chicago & St. Louis portion of the Pennsylvania lines west of Pittsburgh have abandoned the chain-gang system of running locomotives. The plan was tried for a long time, and it was not only found that the cost of repairs was much greater than with the individual system, but that the cost for fuel and stores was decidedly greater. Although more work can be got out of the engines by the chain-gang plan, the additional cost of operating more than offsets the capital invested in engines sufficient to assign them to individuals.

The Joint Committee of the Master Car Builders' and Master Mechanics' Associations met at Buffalo, August 14th, to decide on the place for holding the next Convention. Saratoga Springs was unanimously chosen, with Congress Hall for headquarters. A committee of arrangements was elected, consisting of Messrs. R. C. Blackall, J. S. Lentz, S. A. Crone, John Medway and J. W. Marden. Arrangements have been made to let the members of the associations have the first choice of rooms up to March 1st.

During a recent visit to Baltimore we found that the large electric motor, designed to handle the business in the Baltimore & Ohio tunnel, spends most of the time in the side track undergoing changes. The railroad men about Camden station do not regard the big motor as much of a success, and there are indications that the cost of pulling trains through the tunnel by electric motors will be much heavier than was anticipated.

BOOK REVIEW.

Motive Powers and their Practical Selection. By Reginald Bolton. New York: Longmans, Green & Co.

The author of this book, who is a well-known English mechanical engineer, was frequently consulted concerning the selection of motive power to suit certain conditions. It is well known that engines are frequently put to do work for which they are not well suited, and on which other motors could be more economically employed. The problem attempted in this book is the guiding of those about to employ motive power of any kind to the selection of the fittest. The work is very well done, all the powers and prime movers employed for industrial purposes having their merits and shortcomings intelligently discussed. There is also a great deal of useful information given concerning motive power that was not previously to be found except scattered through engineering books. It will be a very useful reference for the chief draughtsman and the mechanical engineer.

We are informed by Mr. S. R. Tuggle, superintendent of motive power of the Houston & Texas Central, that the nine locomotives, which we said they had received from Pittsburgh, were built at Schenectady.

PERSONAL.

Mr. J. C. Barber, M. C. B. of the Northern Pacific, has resigned, and the position has been abolished.

Mr. Joseph Cook has been appointed roundhouse foreman for the Atchison, Topeka & Santa Fé, at Raton, N. M.

Mr. J. D. Fort has been appointed roundhouse foreman for the Atchison, Topeka & Santa Fé, at Trinidad, Colo.

Mr. A. A. Campbell has been appointed master mechanic of the Texarkana & Fort Smith, with headquarters at Texarkana, Tex.

Mr. Benjamin Thompson has been appointed assistant engineer of the Southern Railway, with headquarters at Greensboro, N. C.

Mr. F. E. Janowitz has been appointed coal traffic agent of the Baltimore & Ohio Southwestern, with headquarters at Chillicothe, O.

Mr. N. C. Bennette has been appointed trainmaster of the Louisville division of the Pennsylvania lines, with headquarters at Louisville, Ky.

Mr. W. A. Stinchcomb has been appointed general superintendent of the Jamestown & Lake Erie, with headquarters at Jamestown, N. Y.

Mr. A. W. Kelso has been appointed assistant superintendent of the Iowa division of the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Ia.

Mr. R. D. Gibbons, roundhouse foreman at Trinidad, Colo., has been promoted to be general foreman of the Las Vegas division of the Atchison, Topeka & Santa Fé.

Mr. J. H. White has been promoted from assistant to be superintendent of the Fort Worth division of the St. Louis Southwestern, with headquarters at Commerce, Tex.

Mr. Levi W. Morse has been appointed superintendent of the Grafton & Upton Railroad, with headquarters at Grafton, Mass., to succeed Mr. F. W. Morse, resigned.

Mr. J. M. Gruber has been appointed superintendent of the Eastern Railway of Minnesota, with headquarters at West Superior, Wis., in place of Mr. W. V. S. Thorne.

Mr. Geo. B. Harris has resigned as assistant president of the Lehigh & Hudson River, and has accepted the position of engineer of the Reading Iron Company, at Reading, Pa.

Mr. H. D. McClelland, formerly trainmaster of the Western division of the Chicago & Erie, has been appointed trainmaster of the entire line between Chicago and Marion, O.

Mr. M. L. Reynolds has been appointed trainmaster of the Lake Shore & Michigan Southern, with headquarters at West-

field, N. Y., to succeed Mr. Ira A. McCormack, resigned.

Mr. O. McGowen, assistant superintendent, has been appointed superintendent of the Missouri division of the St. Louis Southwestern, with headquarters at Jonesboro, Ark.

Mr. W. Reese has resigned as assistant engineer of the Rochester division of the Western New York & Pennsylvania, to accept a similar position on the Lehigh Valley at Buffalo, N. Y.

Mr. P. J. Conley, who has been assistant superintendent, has been appointed superintendent of the Arkansas division of the St. Louis Southwestern, with headquarters at Pine Bluff, Ark.

Mr. J. J. Purdon, formerly trainmaster of the Alabama Great Southern, at Birmingham, Ala., has been appointed trainmaster on the Plant system, with headquarters at High Springs, Fla.

Mr. H. N. Loomis, who has been for some years identified with the Standard coupler, has resigned, and taken charge of the Western agency of the Trojan Car Coupler Co., with office in Chicago.

Mr. C. F. Lape, who left the position of master mechanic of the Wabash, at Springfield, Ill., to become Railroad and Warehouse Commissioner for the State of Illinois, has resigned the latter position.

Mr. Robert C. Schenck, president of the Dayton Malleable Iron Co., and well known among railroad mechanical men, has been elected a director of the consolidated Cincinnati, Hamilton & Dayton system.

Mr. Oscar Grant, acting general manager of the Wilmington Sea Coast Railroad, has been appointed general manager of that road, with headquarters at Wilmington, N. C., to succeed John H. Daniel, deceased.

Mr. J. Farrington has been appointed roundhouse foreman of the Duluth, South Shore & Atlantic, at Marquette, Mich. Mr. Farrington has been several years a gang foreman in the repair shops of the same road.

Mr. C. A. Boies, chief train dispatcher of the Union Pacific, at Omaha, Neb., has been appointed superintendent of the Idaho division of that road in place of Mr. S. S. Morris, resigned to accept a position with another road.

Mr. Thomas Saunders, formerly superintendent of the Colorado Midland, has been appointed general manager of the Kansas City, Watkins & Gulf, with headquarters at Lake Charles, La., to succeed Mr. F. S. Hammond, resigned.

Mr. W. H. Moore, assistant supervisor of the Cambria & Clearfield division of the Pennsylvania Railroad, has been appointed supervisor of Division 20, including the north end of the Cambria & Clearfield and Susquehanna divisions.

Mr. James Milligan, assistant master mechanic of the Pennsylvania Railroad, at the Altoona, Pa., shops, has been appointed assistant engineer of the Philadelphia, Wilmington & Baltimore, to succeed Mr. A. Kearney, promoted.

Mr. W. S. King, superintendent of the Louisiana division of the Illinois Central, has been transferred to the superintendency of the Mississippi division of the Yazoo & Mississippi Valley, with headquarters at Jackson, Miss.

Mr. John Gailey has been promoted to be general foreman of the Atchison, Topeka & Santa Fé, at San Marcial, N. M. He was for some time roundhouse foreman at San Barnardino, Cal., and later held the same position at Raton, N. M.

Mr. W. D. Holland, of San Francisco, at present sojourning at Puerto Barrios, Guatemala, his headquarters as mechanical superintendent of the Northern Railway of Guatemala, was married on July 13th to Miss Elsa Martens, of New York.

Mr. Alfred Child has been appointed general car foreman of the Northern Pacific in charge of Como shops, with supervision to cover the car department at St. Paul and Minneapolis. He has been car foreman at Como for about ten years.

Our attention is directed by Mr. W. T. Rupert to a mistake made in the name of his road in mentioning his appointment as master mechanic. The correct name of the road is the Detroit, Lansing & Northern, and Saginaw Valley & St. Louis.

Mr. M. McNally has been appointed master mechanic of the Manhattan Railway, in place of Mr. T. W. Peeples, resigned. Mr. McNally was long a general foreman of one of the shops, and has been acting master mechanic for about a year.

One of the best-known and most energetic railroad men is advertising in another column of this paper for a position. Any firm looking for a good, live man to push their business among railroad purchasers, would do well to correspond with this office.

Mr. D. B. Overton, Brunswick, Ga.; Mr. G. M. D. Riley, Savannah, Ga., and Mr. T. M. McDonough, Thomasville, Ga., who have held the title of master of machinery on divisions of the Plant System, have had their titles changed to master mechanic.

Mr. J. F. Dunn, master mechanic of the Idaho division of the Union Pacific, at Pocatello, Idaho, has been appointed master mechanic of the Salt Lake division, in place of Mr. David Patterson, who will remain in charge of the Salt Lake shops with the title of foreman.

Mr. T. R. Freeman, the well-known railroad supply man, has accepted a position with the Boston Belting Co., and will represent them in the West, with headquarters in Chicago. Mr. Freeman was until quite recently with the Hale & Kilburn Mfg. Co., Philadelphia.

Mr. Geo. A. Gallagher, who was for some time roundhouse foreman of the Duluth, South Shore & Atlantic, at Marquette, Mich., has accepted the position of general foreman, in charge of motive power and car department, of the Lake Superior Terminal & Transfer Ry. Co.

Mr. R. E. Wells, who was appointed assistant to the president of the Santa Fé, Prescott & Phœnix, a short time ago, has now been made assistant general manager of the road, and will also look after the duties of the office of superintendent of transportation. Headquarters, Prescott, Ariz.

Mr. Charles W. Jones has been appointed superintendent of the Southwestern division of the Chicago, Rock Island & Pacific, west of the Missouri River, with headquarters at Herington, Kan. He has been assistant superintendent of the Iowa division since last February, and previous to that date was trainmaster of the same division.

Messrs. W. Bryan and C. H. McKibbin have formed a partnership under the name of Bryan & McKibbin, to handle railway, steamship and contractors' supplies. Both these gentlemen are old railroad men with a wide acquaintance. They are on the lookout for good specialties to handle. Their office is at 120 Broadway, New York, where they invite old friends to call.

Mr. O. Stewart, superintendent of motive power and equipment of the Bangor & Aroostook, writes that he is unusually busy this summer. His company is building a branch 42 miles long, and the extra work falls heavy on the motive-power department. The company is about to order considerable new equipment, to be ready for the extra business which the new branch will furnish.

A circular has been issued by Mr. L. B. Paxson, superintendent of motive power and rolling equipment of the Philadelphia & Reading, that Mr. E. E. Davis, assistant superintendent of motive power, will have immediate charge of all locomotive shops of the company. We understand that Mr. Davis is making an enviable record in his management of the chief shops of the company, at Reading, Pa. With no increase of force he has increased the output of the shops about 30 per cent. When Mr. Davis was with the Boston & Maine, railroad men in New England generally admitted that he was the best shop manager in that region. His ability in this line is counting in Reading.

Mr. G. W. Ettenger, who was for some years chief draftsman, and afterwards division master mechanic, on the Chesapeake & Ohio, is now partner in a car-building firm, with headquarters in Dashwood House, London. Mr. Ettenger has recently invented steel tubular under frames for cars which the firm is putting upon the market. One style of frame is constructed on the cantilever principle, the other an ordinary frame. As now arranged, the frames are interchangeable for all classes of freight cars. Special attention has been directed to convenience for repairing. With very little labor the frame can be detached from the body and floor, rendering all parts readily accessible for repairs.

EQUIPMENT NOTES.

Rogers have received an order for sixteen locomotives for Chili.

The Toledo & Ohio Central are said to be in the market for 200 coal cars.

The Philadelphia & Reading car shops at Reading, Pa., are building fifty box cars of a new design.

The Brooks Locomotive Works have received an order from the Santa Fé & Pacific for two locomotives.

The Mount Vernon Car Works have received from the Cleveland, Lorain & Wheeling an order for 150 coal cars of 60,000 pounds capacity.

The Richmond Locomotive Works have received orders for eight locomotives from the Southern Railway, and for two engines from the Augusta Southern.

It is reported that the Canadian Pacific people are negotiating with the Wells-French Car Works for the building of a large number of freight cars.

The Rhode Island Locomotive Works have received orders for five locomotives from the Boston & Maine, and six from the New York & New England.

The amount of live stock moved by the Atchison, Topeka & Santa Fé this season is reported to have been the greatest in the history of the road. Most of it came from New Mexico.

The Calumet & Blue Island have placed an order for 200 box cars, 34 feet long, of 60,000 pounds capacity. They will have Westinghouse air brakes, Tower couplers and Fox pressed steel trucks.

The Illinois Central have placed orders for thirty locomotives. Brooks have got eighteen and Rogers twelve. Most of the engines are moguls, with cylinders 19 x 26 inches; total weight, 126,000 pounds.

The Baldwin Locomotive Works have received orders within the month for one engine for the Cleveland & Marietta, three for the Paulista Railway of Brazil, several for the Cincinnati Southern and the York Southern of Pennsylvania.

The St. Louis Southwestern have built in their shops at Pine Bluff, Ark., a heavy eight-wheel passenger engine after the design of Mr. R. M. Galbraith, master mechanic. The tender has a vestibule designed by Mr. Galbraith.

A circular has been sent out by Secretary Sinclair, of the American Railway Master Mechanics' Association, intimating that the examination of candidates for the Association's scholarships in the Stevens Institute of Technology, Hoboken, N. J., will begin on September 16th.

The Union Pacific, Denver & Gulf have placed an order with the Madison Car Works for 100 box cars of 60,000 pounds capacity, 32 feet long, and 120 box cars, 34 feet long, of 60,000 pounds capacity, and 30 coal cars. All will have Westinghouse air brakes and automatic couplers.

The Chicago, Burlington & Quincy have lately built at Aurora, Ill., two mogul compound locomotives known as their Class H. One of that class of compounds has been in service for several years, and her satisfactory performance led to the building of the other engines. They are also building four simple moguls of the same class in the shops at Aurora.

The report of the proceedings of the twenty-eighth annual convention of the American Railway Master Mechanics' Association was sent out to members early in August. The report contains 331 pages, and is the largest ever published by the Association. The reports of committees are unusually valuable, and the text is illustrated by a large number of engravings. The report can be got from the Secretary, 256 Broadway, New York, for $1.50 per copy.

It does not take much keenness of perception to notice that the men employed on electric-car lines are a superior class to those who run the horse cars. Street railroad companies are devoting more attention to the education and training of their men than most steam railroad companies are doing. In an interview with a representative of the New York *Evening Post*, the president of a St. Louis street railway said: "It takes a higher order of intelligence to manage a trolley than it does to drive a mule. We have regular schools of instruction now which the men must attend, and this has brought the best of them forward. Ability is quickly detected by the questions asked and the interest taken, and wherever ability is found it is marked for promotion. The school of instruction is steadily reducing the percentage of accidents, and we expect to get this average below the old average on horse-car lines. Drink has been absolutely prohibited among employés, and the well-remembered mulewhacker, whose capacity for whiskey was only exceeded by his versatility in profanity, is of the past. He has been weeded out."

One of the finest trade catalogues that has lately come to our office is entitled "Fuel Handling in Locomotive Coaling Stations." This is an instructive collection of photographic blueprints that tell the whole story with a simple caption under each. Type could not have told it as well, nor in twice the time and space. It is issued by the Link-Belt Engineering Co., of Nicetown, Philadelphia, and will be sent to railroad officials free.

Hilles & Jones Co., of Wilmington, Del., have just issued a very handsome catalogue (standard size, 9 x 12 inches) of their special tools for boiler, bridge, car, locomotive and ship-yard shops. The book is made up of large, fine, half-tone engravings without other description than the captions under them. It should be in the hands of every motive-power man from foreman up.

Southern Railway Shops at Knoxville, Tenn.

The city of Knoxville, Tenn., indulged in a sort of gala day on August 8th, so that its citizens could avail themselves of an invitation given by the Southern Railway Company to go and witness the formal opening of the fine new machine shops which have just been finished, near that city, for the repairing of locomotives and cars.

The buildings are all substantial brick structures, on stone foundations, arranged on the parallel plan. The machine shop and erecting shop is 101 x 321 feet. The blacksmith and boiler shop comes next, which is 90 x 321 feet, part being walled off to separate the two shops. Beyond the iron-working shops we come to the wood-working shops, 91 x 321 feet. This building is also walled off into two parts, one division being the planing mill and the other a car-erecting shop. Farther on is the paint shop, 91 x 321 feet, the whole of which will be devoted to the painting and varnishing of passenger cars.

Besides these buildings there is a roundhouse, which will accommodate sixty locomotives, when completed. Twenty-five stalls are now done. The stalls are 70 feet long, and there is a 60-foot turn-table in the center. The roundhouse is built with every facility for drainage and washing out of engines. There are several drop pits, the apparatus to be worked by compressed air.

Apart from the main buildings is a dry kiln for drying lumber, 40 x 85 feet. There are also oil houses and a variety of other offices, arranged in the most convenient form.

All the shops have been equipped with the most approved machinery and appliances for doing work expeditiously.

The shops are said to be the largest in the South, and when in running order will give employment to 1,500 men. The buildings were designed by Mr. C. H. Hudson, when he was general manager of the East Tennessee, Virginia & Georgia Railroad, and the equipment was put in under the supervision of Mr. W. H. Thomas, assistant superintendent of motive power of the Southern Railway.

Something new and good as a nut lock is the "Kleman," just put on the market by the Allison Manufacturing Co., Philadelphia, Pa. It consists of a combination nut, having a countersunk cavity on its inner face, and an annular tube-ring divided washer fitting in the countersunk recess, the washer being made of a sufficient depth that when the nut is tightened on the bolt the washer will project from the recess and bear against the plate or bearing. The nut lock has been subjected to severe, protracted trials of the most searching service and has given entire satisfaction. It is particularly well adapted for track, trucks, and any service where vibration loosens ordinary nuts.

Norfolk & Western System of Maintaining Standards.

In the course of a brief visit to the mechanical offices and shops of the Norfolk & Western, at Roanoke, Va., the writer was struck with the systematic fashion in which the business is conducted and the smooth way it moves forward. Mr. R. H. Soule, the superintendent of motive power, has been always noted as a fine organizer, and his work here has given the company the finest system of office, store and shop management I have ever seen in operation.

The general plan of the system calls for a strict supervision of every article received for the use of the company, to insure the quality and quantity being what was purchased; the working towards an intelligent purpose of every man employed by the department, and the keeping of accurate records of what has been accomplished. There are details of office, drawing room, laboratory, storehouse and shop management which will give valuable information to railroad men, but I must omit them for the present to give space for a department of work which is conducted in a very unsatisfactory manner on most roads. That is the maintaining of standards.

The railroad is very poorly managed that to-day does not have nominal standards for all details of locomotives and cars; but on many roads the keeping up to the standards is more honored in the breach than in the observance. On some fairly well-managed roads the master mechanics, master car builders and general foremen at out stations have very little accurate information of what the standards of the company are, and wrong material and wrong forms are frequently used in doing repairs, because the men in charge are not sufficiently conversant with details of the standards. Drawings have been issued, from time to time, of the standard cars and locomotives, but they are stored away and it is not easy consulting them about details, and so a locomotive or car has a tendency to gradually deviate from the standard of parts which it had when built.

Perceiving the advantage it would be in the interests of uniformity, that every man in charge of repairs should possess a record of standards adopted or of changes made on existing standards, Mr. Soule instituted a system of circular "notifications of standard," which is sent to every official in charge of work. These notifications of standards give a brief description of the form adopted, and refer to the blueprint, which contains full particulars. These notifications are filed, and become a standing reference for the standard dealt with. The notifications are sometimes of standards adopted, and at other times they relate to standards changed or to new designs. Occasionally they notify all concerned of a new style of some article which has been adopted, or a changed location for some attachment. One of the latest notifications reads: "Hereafter counterbore bolts, as per print S. C. 97, should be used in locomotive construction and repairs, instead of countersunk bolts such as have hitherto been generally used. These counterbore bolts should not only be used in all new work, but should also be used in renewals of old work whenever possible."

The total number of these notifications has been about 350. They relate to every variety of detail of locomotives and cars. As these notifications would be confusing after they became numerous, they have been indexed, so that a master mechanic, car builder or general foreman wishing to know what has been done concerning any particular part, turns up the index and has the information at once. For instance, the index tells him that Notifications 13, 73 and 196 relate to tender axles, and they also apply to passenger and freight-car axles. Truck boxes, crank pins, cylinders, journal-box wedges and brakes are parts of locomotives that have been subjects of more than one notification; while axles, journal bearings and wheels of passenger cars have required the most notifications. Among details of subjects, as found in the classified index, notifications were issued on classification of locomotive repairs, limit for turning and wear of locomotive tires, pressure for mounting wheels, axles and crank pins, specification of stay-bolt iron, method of attaching cylinders to frame, standard of equalized brake for Class S engines, location of cocks in air-brake pipes, collars to be removed from driving axles and truck axles, consolidation engine bald tire to be 7⅛ inch wide, location of saddle pin for Classes F G and I, and of many others for cars and locomotives of a similar character. It will be seen from these specimens, that the purpose of the notification of standards is in a general way current information respecting all changes introduced in the machinery department.

The practical effect of the system is the promotion of uniform practice in the repair shops, and a tendency to make parts interchangeable. This reduces the cost of repairs so much and facilitates doing so much of the work promptly, that the clerical expense of keeping the system going cuts no figure. Of course, no one is authorized to change a standard or adopt a new one except the superintendent of motive power. A. S.

The Railway Master Mechanics' Association have adopted as standard a system of decimal gages for sheet metal, wire, etc., which ought to meet with immediate acceptance in all railroad shops. This system of measurement will end the confusion that arises from thicknesses being specified according to numbers of certain gages, such as Birmingham, Stubbs, etc. The new standard gives a positive measurement in parts of an inch, a plan which appeals to every mechanic and person accustomed to systematic methods.

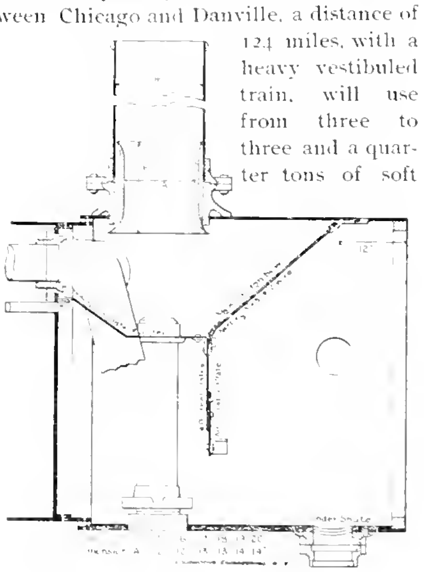
Curtis Extension Front.

The following description of the annexed engraving was sent us by Mr. Allen Cooke, superintendent of motive power of the Chicago & Eastern Illinois:

"The accompanying illustration shows a smokebox arrangement which has proved to be a wonderful success on the Chicago & Eastern Illinois R.R.

"The choker in the stack we make of cast iron, and it rests on lugs fastened by the saddle bolts. A small table of dimensions gives the different diameters of chokers for the different size cylinders. The diameter of the stack is standard for all sizes of engines. In all other respects the drawing is sufficiently self-explaining.

"This arrangement has showed itself to effect a coal saving of 50 per cent.—beats the compound all to pieces—which can be verified every day by actual work and not by manipulation of the performance sheets. An 18 x 24 passenger engine, running between Chicago and Danville, a distance of 124 miles, with a heavy vestibuled train, will use from three to three and a quarter tons of soft



coal for trip when fitted up in this manner, whereas others of the same class of engines not so fitted will use about seven tons per trip. Other engines on other routes use in the same proportion.

"Our 18 x 24 switch engines will use about two tons of coal for twelve hours' continual work—and this with no fancy grade of coal, either, but with common, everyday grade.

"This arrangement has also showed itself to be almost self-cleaning, as there is hardly more than a shovelful of cinders left at the completion of each trip, and the front of an engine which came into shop the other day after a year's service shows no sign whatever of having been hot; even the door lining of sheet iron is as perfect as when new.

"One of our ten-wheeled freight engines lost a cinder-chute wedge on the road and the boys put in a pine board. When this was taken out on its arrival at roundhouse, the shingle was not even scorched.

"We use larger exhaust nozzles in connection with this front than before its use, and we are still enlarging them. At pres-

ent our single nozzles are. For 17-inch engines, $4\frac{1}{4}$-inch; for 18-inch and 19-inch, $4\frac{1}{2}$-inch; for 20-inch, $4\frac{7}{8}$-inch diameter, and they give excellent satisfaction.

"Of the engines fitted with this front some are equipped with brick arches and some are not; we see no material difference between them.

"This device has been in use on the Chicago & Eastern Illinois R.R. for about two years, and originated with Mr. J. J. Curtis, division master mechanic at Danville, Ill.

"Several other roads have already adopted it as their standard, showing that they know a good thing when they see it."

Saving from Careful Handling.

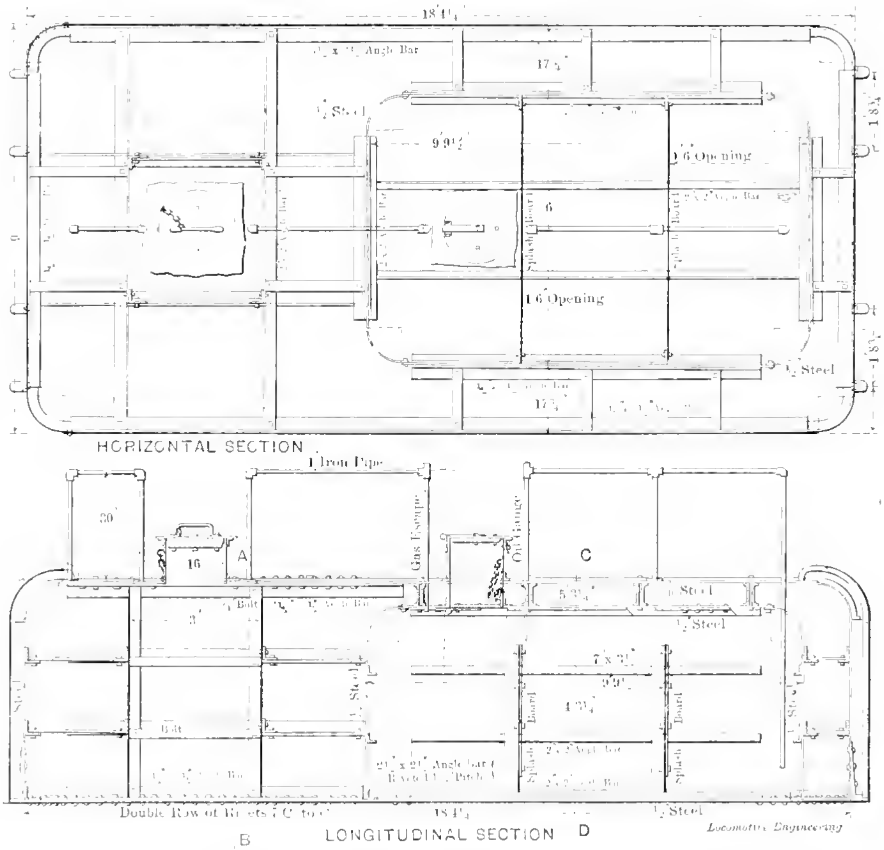
For some months back the mechanical department of the Chicago & Northwestern have been carrying on an energetic effort to improve the fuel record made by the locomotives. Mr. Quayle, superintendent of machinery, issued a circular to engineers and firemen, containing instructions for handling the engine and for firing that would result in fuel-saving if carried out. These instructions were vigilantly followed up by the personal attention of Mr. E. M. Herr, assistant superintendent of motive power. The results of these combined efforts were indicated in remarks made by Mr. Herr at the Master Mechanics' Convention, when he said: "I am not a disbeliever in the economy of the compound locomotive, but, on the contrary, I believe, as it has been stated on the floor to-day, that the compound engine, especially in freight service, gives us an opportunity of a very considerable saving in fuel. I do not believe, however, that all the saving that is found in the operation of some compound engines, either in freight or passenger service, can be fairly attributed to the compound principle. It has been said, and I have not heard it contradicted, that the economy of the compound engines in freight service will approach 20 per cent. I have no doubt that an economy of this amount has been shown in freight service, but I do very seriously doubt whether this economy was attained when the simple engines were given a fair show as compared with the compound. To illustrate more pointedly what I mean in this matter, I can only cite my own experience of the past six months, wherein we have effected an economy of simple engines over results previously obtained by the same engines in the same service, handled by the same engineers and using the same fuel, averaging all the way from 20 to in some cases as high as 30 per cent., with no change in the engines whatever. While such results are obtainable, I think it is very fair to at least inquire pretty carefully into the condition of the single engine with which your compound engine is compared when she effects a saving of 35 to 40 per cent. I fully believe that it is possible to save something in the neighborhood of 15 per cent.—possibly a little more, possibly a little less—over good practice, fairly comparative practice, in the simple engine."

Combined Oil and Water Tank for the Southern California Oil Burners.

We present herewith plan and sectional engravings of a new tender tank to carry both water and liquid fuel, recently built by the Tobin & Hamlin Works, in Chicago, for the Southern California. This road has sixteen engines burning oil successfully, one passenger engine, double crewed, making 8,000 miles per month. No trouble is had with the fuel.

The tank is so constructed that the water surrounds the oil tank except at the bottom. Means are provided to allow of escape of gas from oil tank, and double manhole covers prevent the escape of oil, even though the tank were turned upside down, the lower cover closing from the inside. There is also a sliding rod with which the amount of oil remaining in the tank can be easily measured.

The system of burning oil is the same as has been in successful use for some years in Peru.



The Hall Signal Co. has begun to equip part of the St. Louis, Keokuk & Northwestern with its system of block signals. The contract calls for the equipping of twenty-seven blocks with the most approved apparatus.

Blacksmiths' Association.

In sending out notice that the Railroad Master Blacksmiths' Association will meet at Cleveland, O., September 3d, Secretary Hinkens says:

"The purposes of the National Railroad Master Blacksmiths' Association are to discuss matters pertaining to blacksmithing, and likewise to expose the shortcomings and clannish instincts developed by all trades and specialties.

"Our object is to acquaint each other with a multitude of valuable experiences wherein each assimilates from all. Emulation is stimulated, range of knowledge broadened, secretiveness and self-exaltation become abashed. To some people the chief purpose of the N. R. R. M. B. A. seems to be the reading and printing of papers. While this may be one of the features and of the greatest good to non-attendants, it is but the focusing of all minds for mutual edification and instruction. The printed record is for reference only."

Mr. E. W. Grieves, superintendent of car department of the Baltimore & Ohio, has, in his office, in Baltimore, the most complete car-equipment board we have ever seen. Colored checks indicate the condition of all the passenger-train cars belonging to the company. Red indicates that the car is in good order, white means fair order, and blue indicates that the car needs the shop. Besides the condition of the cars, the board indicates whether they are coaches, express, postal, baggage or combination cars, and also indicates where they are running.

AIR BRAKE DEPARTMENT

To Show the Durability of Hose.

The annexed engraving illustrates a method in use by the Illinois Central for showing how long a hose has worn, which is well worthy of general adoption. It will be the means of putting the durability of hose on record, instead of guessing at it. Exact records are very hard on inferior material. The figures are raised, and are cut off for the year and month of the application of the hose. When the hose is removed, the year and month are also marked, which indicates how long it has been in service.

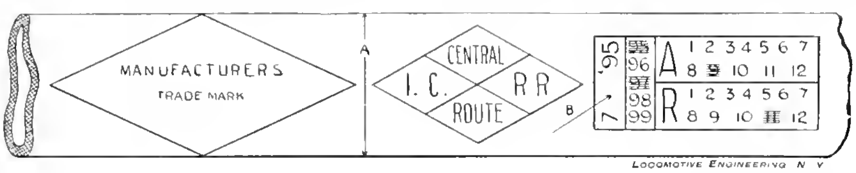
Figures at left side of application and removal record denote month and year of manufacture.

A and Figs. 1 to 12 in upper half denote month of application.

R and Figs. 1 to 12 in lower half denote month of removal.

Figs. 95, 96, 97, 98 and 99 denote year of application and removal.

First year in this column will correspond with year of manufacture, and following years will be the successive four years.



Employés applying hose for service will cut off the figures denoting month and year of such application in upper half of stamp, and when removing same on account of failure or defect will cut off figures denoting month and year of such removal in the lower half of stamp.

If hose is applied and removed during same year, only the figures denoting that year will be cut off.

There Are Others.

A hustling slack-adjuster representative, whose interest and faith in his device is but slightly subordinate to that of his family, attached one of his adjusters to a passenger car of a certain Western line for trial a few months ago. Recently he called around to see how much the car inspectors liked it; at the same time wisely providing himself with a sufficient number of order blanks in his inside coat pocket to carry back the official signature for adjusters for all cars on the entire system, for he conscientiously believed they would be needed—that is, if the trial adjuster's performance had been closely watched.

After a hot and enervating walk through the yards, and sundry ascents and descents of freight trains which blocked his way, the representative, in a state of profuse perspiration, arrived at the end door of a box car, devoid of wheels and mounted on low blocks, which served as a combination office and repair shop for the joint "hot-box detective" and air-brake inspector, who was to soon gladden his heart with good news of the adjuster's splendid performance.

"Hello! Anybody at home?" called the representative, mopping his brow. "I say, McClosky!"

A massive form, clad in a grease-varnished suit of overclothes, to which hung a multiplicity of waste lints, and its head mounted with a Peck's Bad Boy hat, slowly lumbered forth from a corner containing a pile of rusty bolts, screw jacks and dope buckets. The face wore an expression of one highly displeased with being thus rudely aroused from peaceful slumber, and bore evidence of sundry swipes with dirty hands at flies, which seemed determined to play a ten-inning game thereon while the owner snoozed.

"Hello, McClosky!" saluted the adjuster man, handing the "detective" a cigar (for this representative possessed policy as well as faith in his machine), "how is the adjuster doing?"—at the same time feeling for the bundle of order blanks which protruded from his pocket.

"Divil a bit uv gude is the dom t'ing!" replied this custodian of the air brake's health. "I tould the Ould Mon sow, and he said he would take the bloody thing off and scrap it!"

Tableau: The "detective" grumpy and dirty; the adjuster man in profuse perspiration, his skin fairly bursting with the drops of sweat chasing each other out through the pores, he secretly wishing he had brought a hand bag to carry the order blanks in.

"What in thunder is the matter with it?" asked the representative, as soon as he recovered from his choking sensation, and wished he might lie down, if only for a moment, on the bed just vacated by the "detective."

"Phy, the dom t'ing don't work," replied he. "Sure its bin on now moor nor t'ree munts, and divil a bit longer does ther piston come out over eight inches, loike the others, but stands roight there loike as if a block inside the cyllilinther was howldin' it."

Tableau No. 2: Adjuster man's face slowly shakes off the Doomsday look, and gradually takes on a smile which finally broadens into a grin so huge that it musses up his ears. He hands about fifteen cigars to the "detective," and ejaculates: "Well; I'll be d——d!"

Use the same care in filling and looking after your air pump lubricator as you do with your main rod and guide cups, and there will be no necessity for pounding the head of the pump with a hammer or monkey-wrench. When first starting pump, open up lubricator freely for a few moments, and, with a swab on the piston rod, you will forget what it is to have a groan in the air pump.

Don't unnecessarily race your pump, but make it run fast enough to keep up pressure and occasionally make the presence and utility of the governor known. The length of train and amount of work to be done should determine the speed of pump and number of drops of oil per minute the lubricator should feed.

The Boston & Maine Railroad have commenced systematically to equip their freight cars with air brakes. An order has been placed with the Westinghouse Air-Brake Co. to supply 200 sets of freight-car air-brake equipment per month for thirty months.

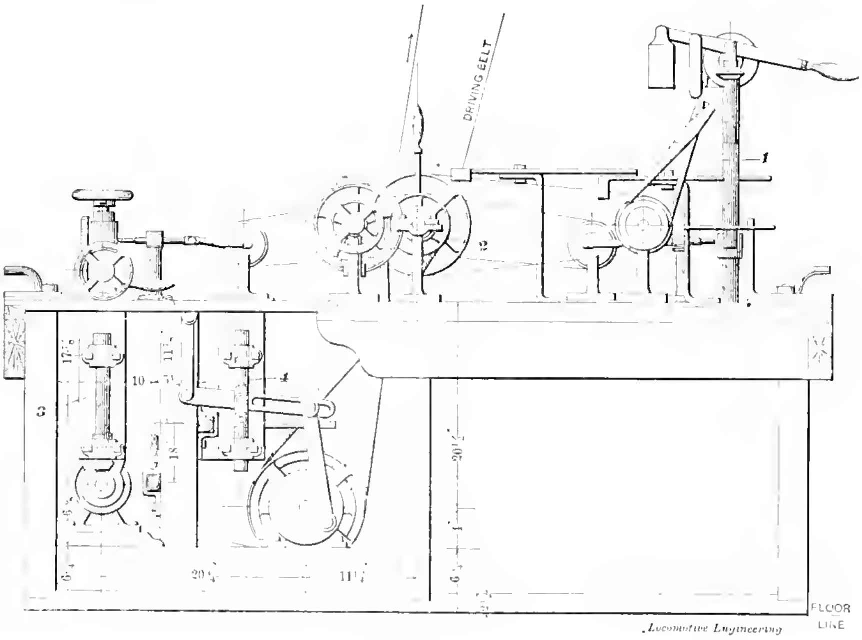
Keep as close an eye on the register of the air gage as you do on the water glass or gage cocks, for it is a friend that is always ready and anxious to tell you something to your advantage, and will do so if you will only permit it.

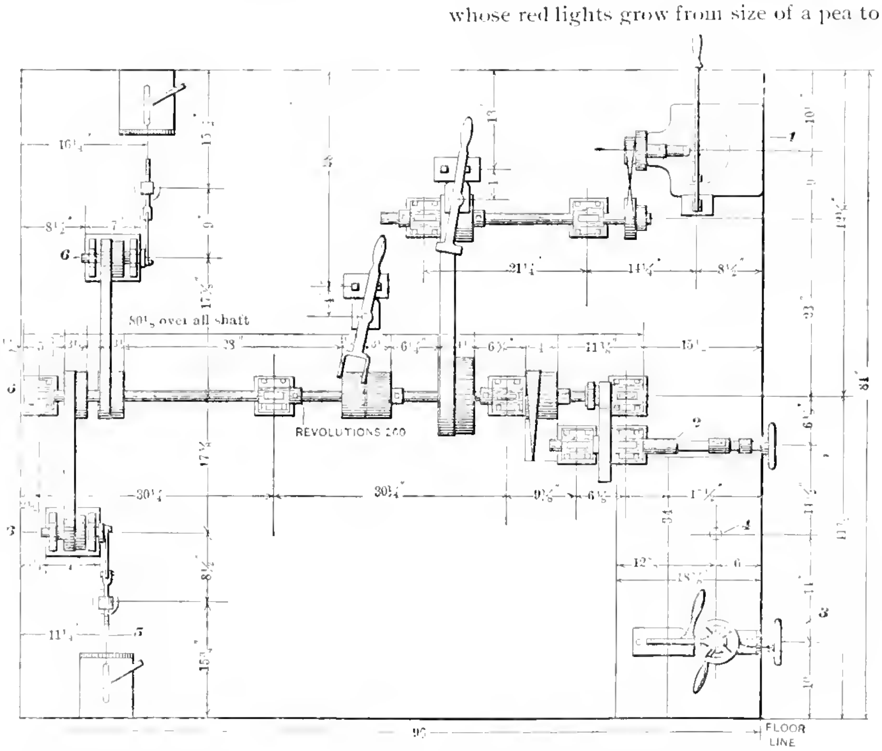
Keep the main reservoir well drained, especially in damp and foggy weather when moisture accumulates more rapidly there, as well as in freezing weather when the most damage from this source is done.

Jigs for Air Brake Work.

Editors :

In your July issue of LOCOMOTIVE ENGINEERING you request those having kinks, tools or jigs for facilitating air-brake repairs, to send you prints of such for publication. I accordingly mail you, under separate cover, a number of blue-prints showing the details of our air-brake plant, which I have had in service in these shops for the past four months and is giving excellent satisfaction.





No. 1 represents a small drill press for drilling all necessary holes in this class of work. This press is also used for reaming and grinding cocks. No. 2 represents an attachment on machine table for overhauling stop and angle cocks. No. 11 is used for trueing off the plugs. No. 12 is used for reaming out the cocks, doing the work very rapidly and accurately. No. 2 has an attachment on machine table for reaming out slide-valve seats in triple valves. Nos. 8 and 9 are a tool for removing dowel pin from triple valve for the purpose of trueing up the valve seat. No. 4 is an attachment on machine table for trueing up the flat or square surface in triple valves. No. 5 are two attachments on machine table for grinding triple valves. The triple valves are attached to this device and slide-valve seat ground in, doing the work very rapidly and accurately. No. 10 is a chuck which is screwed in the ends of the three spindles. No. 6 is for the purpose of attaching the plugs for grinding in stop and angle cocks. No. 13 is also used for the same purpose. No. 10 is a tool or cutter for trueing up the valve seats in engineers' brake valves. The outside diameter of cutter is made just so it will enter chamber, the stem being made a neat fit for the engineer's brake-valve cap. A nut and washer of the proper thickness are used between the disk of cutter and underside of cap nut. By screwing lightly on cap and using a double-ended wrench on the end of cutter, it will true up the seat perfectly true and square with the stem, insuring a perfect job.

The repairs on all air-brake equipment for the entire A., T. & S. F. system are made in these shops. Instructions have been issued to all division points that whenever repairs on an air pump could not be made without removing it from the engine, it was to be forwarded to Topeka. All triple valves, engineers' brake valves, governors, stop and angle cocks, and, in fact, all air-brake material requiring repairs, are forwarded to these shops, which not only means that repairs can be made much cheaper, but more uniform, and standards can be maintained. By this means the cost of air-brake repairs on this system has been reduced to a minimum.

Topeka, Kan. GEO. W. SMITH,
Div. M. M., A., T. & S. F. R.R.

"Ordinary" Emergencies.

Editors :

In glancing over the latest addition to air-brake literature, "An Air Brake as We Find It," by J. W. Shannon and E. Burgess, I was rather startled at some of the instructions contained therein, noticeably the one that suggested the above heading. Question 98 reads: "In ordinary cases (of emergency) how do you apply?" The answer is given, "Bring the handle to direct application No. 5, and reduce the train-line pressure 15 or 20 pounds and immediately lap the valve."

As an engineer seeking enlightenment on the air-brake question, I would like to know what constitutes an "ordinary" emergency. Just where is the dividing line between "ordinary" and "absolute" emergencies, as they are termed in this book? By an "absolute" emergency are we to understand it is that interesting experience when you are on scant time to make the next side track, and you hope the pencil is broken in the "George Washington" in the caboose, when all of a sudden you get a reverse signal from a flagman ten car-lengths from the caboose, whose red lights grow from size of a pea to as big as the Ferris wheel in three seconds; and by an "ordinary" emergency are we to understand water-tank stops and the like? The latter is where the emergency is used the oftenest, and if that is the meaning intended to be conveyed, would it not be better to educate the men up to making such stops in service application as they should be made? In my experience

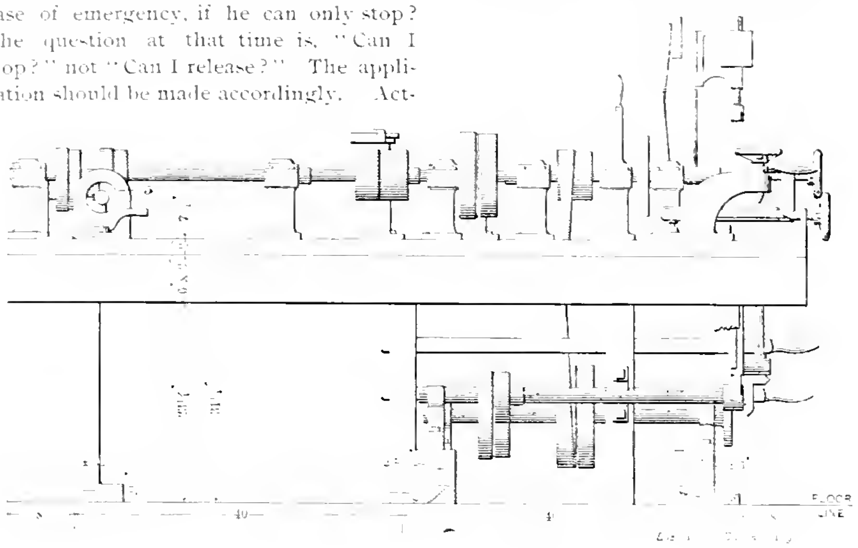
an emergency is a case of danger, and that is the only time, as I understand it, that the emergency application should be used.

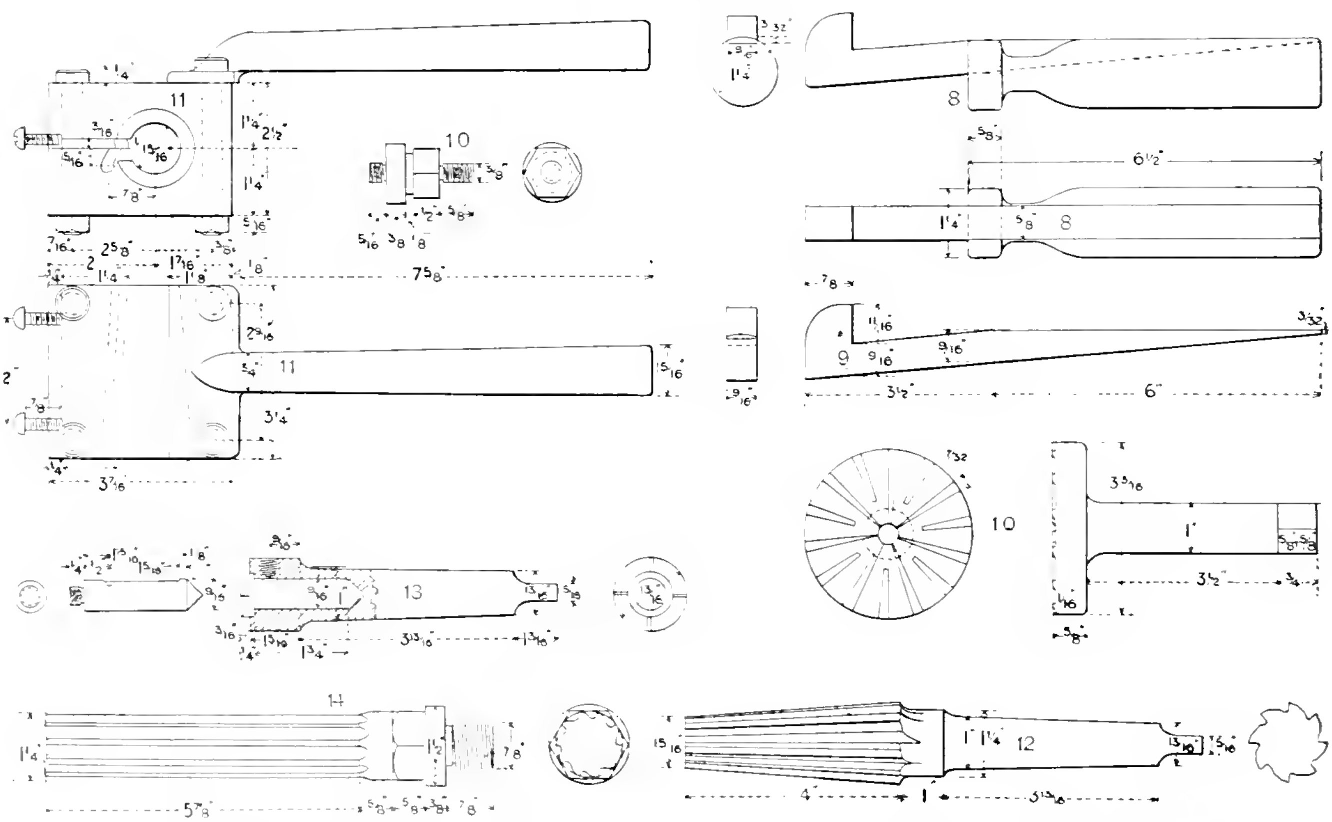
Another thing. Is it advisable to return the handle to lap, as instructed in this book? I say not. Admitting that we do save a certain amount of train-pipe pressure to assist in releasing, what engineer is there who cares if the brakes ever release, in a case of emergency, if he can only stop? The question at that time is, "Can I stop?" not "Can I release?" The application should be made accordingly. Acting on this method, in a case of emergency the handle should be placed in the emergency position, and left there until the train stops or the necessity for stopping is over. If the entire train was composed of quick-action triples in working order, and the handle was placed in the emergency for a sufficient time to start quick action and then returned to lap, quick action would follow throughout the train. Unfortunately we do not find trains always made up that way. There are still a large number of plain triples in service, and on almost all freight trains in the East cars are frequently found cut out. If the engineer has a train with any number of such cars as I have just mentioned, and tries to follow the rule as per Question 98, the results might be disastrous to all concerned, as he would not get quick action throughout the entire train, and the train-pipe pressure left there by the non-quick-action cars would prevent much of an application on part of the train, and might possibly release some of the brakes. This could not occur if the handle was left in the emergency, and though quick action would not be obtained on the entire train, a full service application would be obtained on all operative cars.

The writer saw an experiment of this kind tried with a train of thirty-two cars, six cars being cut out in the middle of the train, all the rest of quick-action triples in working order. With this train applied in the emergency, so as to start quick action, and the valve then lapped, quick action was obtained ahead of the cut-out cars. The rush of air from the rear end of train was sufficient to release all the brakes ahead of those cut out, and not enough reduction was made on the rear cars to hardly set the shoes against the wheels, let alone exert any braking force.

The author says, "Reduce the train-pipe pressure 15 or 20 pounds before returning the handle to lap," presumably to avoid this trouble. How can he tell when he has reduced 15 pounds in the emergency, when the black pointer is connected to the equalizing reservoir, no reduction being made in that pressure in the emergency? Again, what engineer has time to watch the gage in a case of even "ordinary emergency." Nine cases out of ten he wants to use his optics looking for a soft spot to alight on.

The method advocated in the book will work equally well in instruction cars and on trains wholly equipped with quick-action triples in working order, and, no doubt, the day is coming when it may be the proper thing, but that day has not arrived yet. Safety is the first consideration in railroad work at all times, and in a case of emergency, either ordinary or extraordinary, the first thing is to stop. Our air-brake instructors and writers cannot be too careful in their instructions on this point. They should leave no room for a misunderstanding when instructing what to do in a





LOCOMOTIVE ENGINEERING N. Y.

case of emergency, for it may be a case of life and death with some of us fellows who follow their instructions. At the best it may cost us our job, should their instructions not hold as good in practice as they do on paper.

EDW. D. FOWLER.

Jerseyville, Ill.

Improved Air-Pump Rod Packing.

Editors :

Having lately been employed at this point, which is a mountain division of the Santa Fé system, my attention has been called to the great number of reports of air pumps running hot, and on inquiry I have come to the conclusion that in a great number of cases this is caused by defective packing of the glands. As our trains are fully equipped with air, and there is always more or less leak in the train pipe, we have to run the pumps pretty hard to keep up the supply of air when descending mountain grades. In consequence, the packing, which is ordinary rubber or asbestos, quickly gives out, causing air to leak between the packing and piston rod—thus, by the friction, causing a great heat, and in many cases doing serious damage to the pump. Now, it is evident that if any packing, which will effectually prevent leaks and at the same time press lightly on the rod instead of being forced against it by pressure from the gland nut or otherwise, as at present, were introduced, it would not only effect a great saving in pump repairs, but it would also insure a more perfect supply of air, and save engineers no end of trouble in packing pumps.

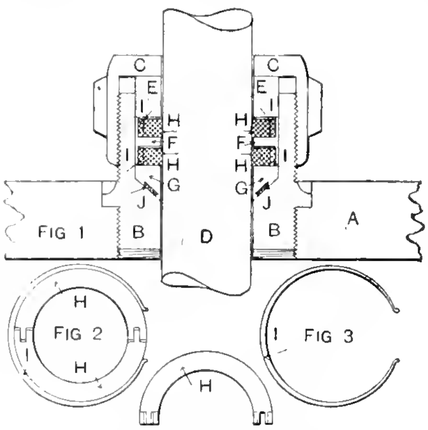
I am aware that there are a few grades of packing on the market which claim to be perfect; but, as far as I have seen, they have all the defect of having to be forced to their place by pressure. To illustrate what I mean : One of the most popular brands of air-pump packing is fitted to its place by a powerful spring in the bottom of the stuffing box, which presses the packing into a V-shaped bushing or cone at top of the box, thus compressing the packing rings until they firmly clasp the rod, thereby making an air or steam tight joint.

I herewith inclose you drawings of an air-pump packing and attachments which has lately been patented by Master Mechanic W. E. Symons and General Foreman Thos. Smith, of this place, and which appears to me to have solved the problem of a perfect pump packing.

G is a brass bushing with a recess in bottom, *J*, which is filled with babbitt. This fits into the bottom of stuffing box, and forms an air or steam tight joint. *F* is a case with a division in center, which sits on top of bushing *G*. In top and bottom of this case is fitted a ring of packing *H*, Fig. 2, which is held to its place by a small spring *I*, Fig. 3. *E* is a ⅝ brass plate, which exactly fits the rod and forms a guide for the same. This plate is fitted on top of the case, and the gland nut is then screwed down tight on top of the plate, thus pressing the bottom bushing to its place, but in no wise interfering with the packing, which moves freely in its case.

The particular feature of this packing is the V-shaped joint, which becomes perfectly air or steam tight when fitted into the case. This packing has been severely tested, and has given splendid results. One test was made in a pump which had been taken out of service, as the air cylinder was out of true and the pump was churning the air, causing intense heat. The pump was run ten hours very hard, and the last four hours the lubricator was shut off and no oil put on swabs. Notwithstanding the fact that the pump was nearly red hot, the packing was taken out apparently none the worse.

It has also been tried on a number of engines in mountain service, and has given like good results. Owing to the slight hold the packing has on the rod, it is only necessary to break the joint of the steam throttle to start the pump to work. As



the outside diameter of packing is always the same, one mold is all that is required to cast the packing rings, only altering the core of mold to cast packing for a rod which has been turned down.

The inventors have also adapted their packing to fit piston glands, valve stems and throttle glands, and I have reason to believe that it will soon be adopted over the entire Santa Fé system. Messrs. Symons and Smith will be glad to answer any inquiries relative to their invention.

ALEX. M. STEWART.

Raton, N. M.

An Old Fallacy Exploded.

Editors :

It may be of interest to some of your readers to know that water, in quite large quantities, is found in the main reservoirs on the electric cars run on the Nantasket branch of the N. Y., N. H. & H. R.R. As the air is compressed by electric pumps there is no such thing as condensation of steam following the piston rod into air cylinder.

This practically demonstrates that a small portion only of the water found in main reservoirs comes from condensation following the piston rod when steam pumps are used, and that no considerable benefit would be derived from running air pumps bottom upwards.

In fact, this practice is a detriment instead of a benefit, inasmuch that the piston rod and air cylinder are robbed of that oily moisture given off by the steam cylinder, and makes it hard to keep the pistons packed. This will be proven by reference to pages 33 and 34 of the Air-Brake Men's Proceedings.

E. G. DESOE,

Air-Brake Insp., B. & A. R.R.

Springfield, Mass.

[Mr. Desoe's observations correspond with the results obtained in a series of tests made by the Westinghouse Air-Brake Co., at their works several years ago, to determine whether it would be advantageous to reverse the position of the cylinders of the air pump. Two pumps, one inverted, and the other with steam end up, were run continuously under precisely the same conditions for 142 hours. At the end of that time the water was drawn off the reservoir of the inverted pump, and weighed 25 pounds and 8 ounces. That from the reservoir of the other pump weighed 25 pounds and 10 ounces. This test proved that but 2 ounces of water followed the piston rod, and that the remainder was the natural precipitation of moisture of the air under compression. Damp and rainy weather requires more frequent draining of the main reservoir.—ED.]

Overhauling Driver-Brake Packings.

Editors :

As LOCOMOTIVE ENGINEERING solicits kinks and special methods for caring for air brakes, it has occurred to me that a few words on the care of the pull-up style of driver brake, such as is placed between the drivers on the American eight-wheel engine, might, perhaps, be timely, or at least provoke a discussion which would result in a materially increased efficiency of this class of brake.

Suppose we need a new packing leather in the cylinder, a gum joint in the bottom cylinder head, and a new piston-rod cup leather. The ordinary method is to disconnect the hangers from crosshead, the latter from the piston rod, remove the lower head, and take out the worn parts. The packing leather will probably be found to be burnt to almost a crisp from its exposure to the firebox heat, and is, consequently, renewed. In replacing, the piston head is introduced edgewise into the bottom end of cylinder, and worked into its proper position, usually, but not always, with the expander in place and the leather uninjured. The gum joint is then renewed, and the piston-rod cup leather, with its spring, is screwed over the threads on end of piston, cutting the leather and

expanding the spring. When the job is finished, the repairman's forcibly expressed opinion of the pull-up brake discloses his misgivings of it

My method of doing this work is, I believe, easier and more lasting, and is as follows: First remove the top head, and if necessary to renew the gum joint in bottom head, disconnect the crosshead as before, and push piston out at the top end of cylinder, thus giving more freedom for the wrench when working on bottom head.

After cleaning the joints, take sufficient candle-wick to go three times around the joint of lower head, and after saturating with white lead or varnish, place it evenly around the joint untwisted, and fasten the head tightly to the cylinder, where it need not be disturbed in future renewals of working parts. When ready to replace the piston and renewed leather packing, I take a former made of Russia iron, 5 inches wide and 25 inches long, bent in a circle, with lugs on each end similar to a jacket band, and draw the leather and expander into shape, for easy entrance to the cylinder, with a bolt passing through the lugs.

A half-inch from bottom edge of the band, spaced about 8 inches apart, are three lugs which hold the packing former from going into the cylinder and allow the piston to slip to its place. *Thus I know that the expander is in place and the leather does not double back.* Should the follower plate be too small to retain the expander ring, as is sometimes the case with considerably worn packing leathers, two leathers may be used, one on top of the other; or, instead of the second leather, a filler of any material may be employed. Expander rings should be concentric with the bore of the cylinder. Beveling the inside of the leather will assist in making a tight joint between the packing and bore of cylinder. Some good oil left in the cylinder is a good investment, after which the top head may be replaced.

To slip the cup leather over the threaded end of piston rod without cutting, I make a tube of thick tin about six inches long and one and three-eighths in diameter, open on the seam, which is placed on the thread, and spring and cup leather are slipped over it safely. Then with pliers on top of the spring and bottom of the cup leather, the spring is worked to its place and packing nut entered.

It will be found convenient to have an air gage to screw into the cylinder, to test the tightness of the packing, and also adjust the piston travel so that 70 pounds train-pipe pressure will give about 52 pounds in the cylinder with the emergency application.

A short time since the writer had an engine upon which 52 pounds cylinder pressure was had with a certain travel, but on another engine of the same class, where more piping was used between the triple and brake cylinder, a shorter travel was required to obtain the same pressure.

There seems to be well-founded objections amongst air brake men to lagging the brake cylinder; some contending that if lagging is used at all, it should be placed between the firebox and cylinder, instead of the reverse, which is the common practice. GEORGE HOLMES.

Roanoke, Va.

[It has been our experience that the rubber gasket leaks usually on account of the bolts working loose, rather than burning out. However, should the cylinder be sufficiently close to the firebox to cause the gaskets to burn out, as the article infers, it would seem less expensive to order harder gaskets than to use lamp wick and varnish.—ED.]

Rogers' Pocket Primer and Question Nine.

Editors:

As you have "taken my name in vain" in Question 9 of the Air-Brake Department of your August issue, I think I have a justifiable right to "rush into print" and correct your air-brake expert. I find from experiments with an absolutely perfect air plant that the figures given in my primer are right. The W. A. B. Co.'s book is also right, for they knew well the lack of especial care and attention their apparatus would receive after leaving their control, and their book is so prepared as to make all things safe if their advice is but partially listened to.

There was one thing that confused me a little in the August number, and that was the story about "Rat" Hogan. I have always been under the impression that continued applications without recharging were what made brakes "stay off" when we wanted them on, and that too great excess in the car auxiliaries was what made them "stick"; but then probably "Rat" was one of those fellows who always shut the pump off as soon as they leave the terminal yards. W. S. ROGERS, M. E.

Buffalo, N. Y.

[We are still of the opinion that the W. A. B. Co.'s figures, as given in their instruction book, are much more reliable and correct than those furnished by Mr. Rogers, and as both cannot be right, we would suggest that our readers, who have facilities for doing so, make tests as per Question 9, and satisfy themselves on this point; also acquaint us with the results. No; "Rat" Hogan's brakes did not "stay off," but could be applied lightly. Rapid and continual applications, without recharging, do not allow all brakes to release before they are made to apply again; thus, some brakes "hang" or "stick," especially where piston travel is not uniform and train is long. We confess our error in not stating that, with this manner of braking, the excess pressure was frittered away with each release.—ED.]

Pressure Increases When Subjected to Greater Heat; Also Decreases When Temperature Is Lowered.

Editors:

The cause of the "Queer Antics of a Tender Brake," as described in last month's number of LOCOMOTIVE ENGINEERING, was as follows: The feed port in triple valve was partially closed by foreign matter. When the steam and hot water came in contact with the auxiliary reservoir, the temperature was sufficiently increased to raise the pressure higher than that in the train pipe. The feed port, being partially clogged, would not allow the air to flow from the reservoir to the train pipe fast enough to maintain an equalization between the two; consequently the triple-valve piston was forced down, and an application of the brake followed.

Chicago, Ill. GEORGE B. SNOW.

[J. P. Kelly, East Hartford, Conn., W. De Sanno, Indianapolis, Ind., and C. L. Silver, Richmond, Va., have correctly answered this question.—ED.]

Wants Better Brakes on Pullman Cars; Also Better Quality of Sand.

Editors:

In discussing the prevention of slid flat wheels, I would say, Don't lean too heavily on engineer when he has three or more Pullmans on, which are probably under-leveraged, and with pistons having full travel, and the other cars in train having to hold all this extra weight. I have often been thus situated, and found that I had to begin braking away back further from stopping point than when I did not have those cars on. All of them are not bad, perhaps, but I have found a great many with bad brakes. You have to brake so much more on the cars with good brakes, and this partly explains why more wheels are slid on railroad company cars and on through trains than on local trains on some roads.

Through cars are let go from terminals with as little work as possible, trusting that the fellows at other end of line will fix them up, and thus they are run with bad brakes nearly all the time. The trains that should have best brakes often have the worst. An engineer don't feel like making up lost time when he knows that train has not more than one-third or one-half the braking power it should have. It seems that officials frequently are not aware how poor the brakes are on some fast trains.

Speaking of the use of sand, many roads buy or dig out stuff that passes for sand, and congratulate themselves that they are getting something cheap for locomotive use, but if those officials appreciated the wear of tires from useless slipping, the wear of rails, the breaking of trains, stalling on grades, waste of fuel, and delay to traffic resulting, simply because the dry mud that passes for sand will not hold a locomotive even when both rails are cov-

ered with it, they would likely buy crushed rock or first-class sand, and educate their engineers to be economical in using it.

Washington, Pa. J. J. CLAIR, Locomotive Engineer.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(13) A. J. McL., Petersburg, Va., asks:

Why can't I carry handle of brake valve in running position without brakes applying? Every time I try it, red hand on gage goes up to 100 or more, and black hand drops back. Other valves of the same kind (D 8) on other engines do not give this trouble. *A.*—Your excess-pressure valve spring is too stiff, or else the excess valve itself is gummed up, either from using too much or poor quality of oil in air cylinder of pump, or from continued carrying of handle in full release position. The brake valve usually plays this trick every time the traveling engineer gets on to ride with you. Are we right?

(14) C. C. L., Buffalo, N. Y., asks:

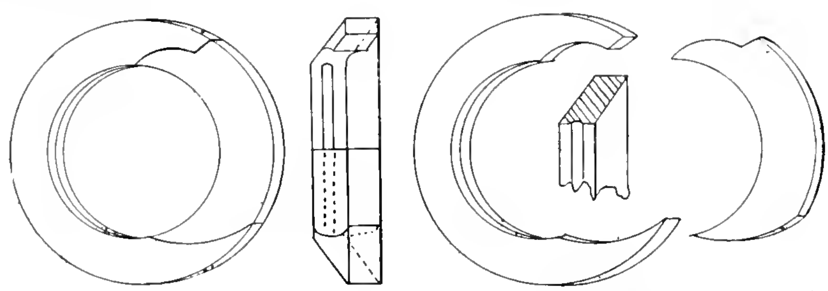
What causes the air whistle to sound on one of our engines every few minutes when engine is moved slowly, but when engine is coupled to train and running either fast or slow, whistle never sounds except when signal valve is operated in coaches in usual manner? Application or release of air brakes does not affect the whistle; it simply sounds of its own accord. We found reducing valve, whistle valve and all pipes and connections apparently in good condition. *A.*—Stem of signaling valve fits too snugly in its bush, or is gummed. This, combined with small, unnoticeable leaks in signal line of engine or tender, causes whistle to sound with no apparent cause. When coupled to train, the volume of signal-line pressure is increased, and leaks lose their influence over signaling valve. Note what pages 93–96 of Air-Brake Men's Proceedings, as described in July number of LOCOMOTIVE ENGINEERING, say about this.

(15) J. L. B., Utica, N. Y., writes:

Can an engineer with his brake valve release any single brake or number of brakes in his train which he wishes, and not release any of the others? A friend of mine says he can. I claim it is impossible. Please decide. *A.*—It is impossible. The most convincing way to decide this is to take a train, have him apply the brakes, and you stand on the ground and call off which ones you wish released. This will knock a big hole in his good opinion of himself. Long piston travel releases with a lower pressure than short when brakes are set full. A car could be thus "doctored," and would be the first or easiest to release, and your friend would carry his point. With pistons all adjusted uniformly, those nearest the engine would be first influenced by the entrance of pressure to train pipe. This is also true where brakes are but lightly applied on train where piston travel is not uniform; but on a train of the latter kind, when applied full, the brakes having long travel will release first, especially if pressure is restored slowly in train pipe. A heavy excess suddenly thrown in will cause all to start at same time.

(16) R. A. J., Shamokin, Pa., asks:

1. What is the difference between straight air and automatic? *A.*—With straight air, the pressure for the brake cylinders of the entire train is stored and carried in the main reservoir on the engine. With the automatic system, each car carries in its auxiliary reservoir its own individual pressure for its cylinder. The train-pipe pressure is a counter pressure to the auxiliary-reservoir pressure, and if maintained equal to the auxiliary-reservoir pressure, brakes will remain released. If reduced below auxiliary-reservoir pressure, brakes will apply.. Main-reservoir pressure is used to restore pressure in train pipe to release brakes and recharge auxiliary reservoir after an application has been made. 2. Is the automatic used on mountain roads? *A.*—Yes, exclusively, with the exception of a few narrow-gage cars in the Far West. 3. Wherein is the automatic superior to the straight-air brake? *A.*—If a straight-air train broke in two, brake could not be applied on cars broken off. No one could apply brake but the engineer. With the automatic brake, any reduction of pressure in the train pipe, whether made by train crew, at any car, or accident to the brake, will cause it to set on all cars. With the straight air, an accident would not manifest itself until an application was attempted. With the automatic, it manifests itself immediately. 4. Which is the stronger? *A.*—Both are equal, providing pounds pressure and leverage are equal.



LOCOMOTIVE ENGINEERING, N. Y.

A New Air-Pump Packing.

Our engraving shows one ring of a new form of metallic packing for air pumps, using the old gland, and one that can be applied without disconnecting.

There is a bottom ring, coned top and bottom, cut the same as this one, and on top of this are placed three of these coned rings, the hollow side down.

It will be seen that there is a groove cut around the interior of each ring; this catches oil and water, making a lubricating point.

The form of the cut insures a fit on the rod before dropping the ring into the stuffing box.

The only directions sent are a caution to break joints with the rings when put in, and to not tighten gland until steam is used, then just enough to make a joint.

No rings need ever be taken out; when worn down, another ring may be dropped in on top of the old ones, and thus renew the packing.

This is an inexpensive metallic packing, easily applied by any engineer, and will save lots of trouble and grief. It is made by the Columbian Metallic Rod-Packing Co., of Philadelphia.

That it pays to "stick to standards," and have specially retained mechanics do air-brake work, is evidenced by the experience of Geo. W. Smith, M. M., of the A., T. & S. F. R.R., at Topeka, Kan., as given in another column.

Two new books, "Evolution of the Air Brake," by Paul Synnestvedt, and "An Air Brake as We Find It," by J. W. Shannon and E. Burgess, are the latest recruits in the air-brake field, and were received too late for mention in our August issue. The former was first printed in serial form, but has recently been revised, and with additional matter has been bound in book form, and makes an interesting and instructive history of the air brake from its incipience to the present time. The latter makes its *debut* in air-brake society, and after having carefully examined the book we must confess we are not over-sanguine of its success, except in its own locality, where, unlike the prophet, it may not be without honor. We cannot indorse any work which aims at instruction unless it is scrupulously accurate, applicable to all sections and classes of service, and has a basis or objective point upon which to build, and disseminates healthy information in a clear and comprehensive manner with every nail that is driven.

It ofttimes pays to form a class of yourself and fireman to study the air brake together; he will prove handy in following the numbers and passages on the chart while you read the instructions from the book and relate your experience.

Start the air pump slowly; it not only allows the pump to make a cushion for itself, but saves the fireman from going over the front end and headlight again.

Look out for the "fake wizard" who claims he can apply or release any single brake he wishes without disturbing the others. Make him do it or shut up.

Try to avoid placing your foot on air pipes for a brace when reversing engine, as carelessness in this will frequently create a cause for "mysteries."

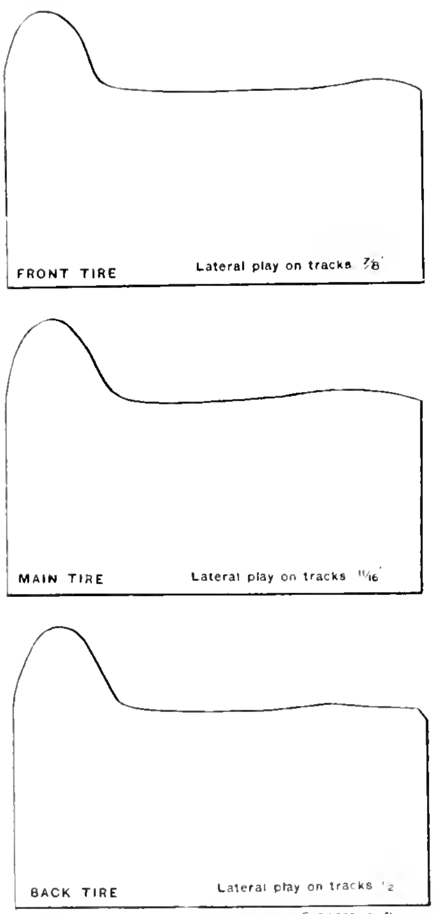
Have you got Conger's book on air brakes? It's the best information for engineers and firemen.

PRACTICAL LETTERS FROM PRACTICAL MEN

Blind Tires on Locomotive Drivers.

Editors:

As you are aware, we recently had a discussion on the above subject, and as one not seeing the necessity of blind tires, I send you b'ueprints of three engines showing flanges on all wheels, and which we consider about right. We have arrived at that decision by watching closely the ruts in the ties formed by coming in contact with the rails—or, in other words, by closely watching the tread wear—and



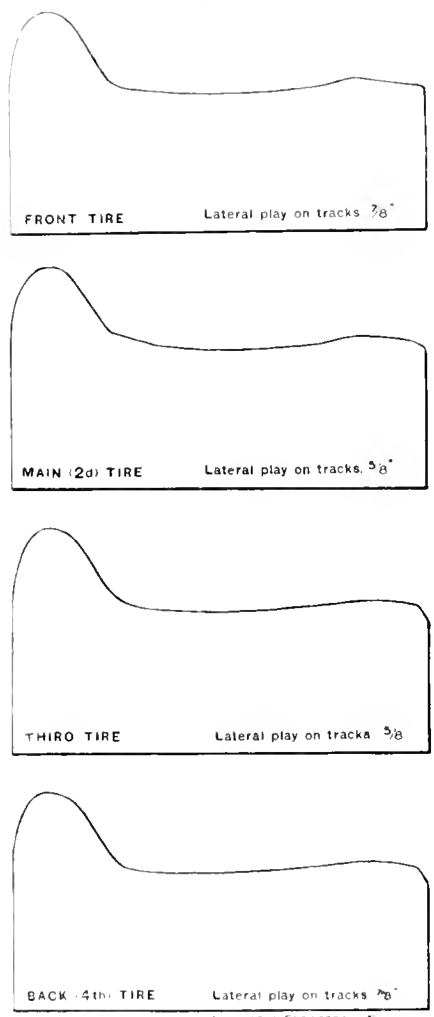
TIRE SECTIONS FROM ENGINE 15; TEN-WHEELED; IN SERVICE SINCE LAST TURNING, FIFTEEN MONTHS, MAKING 69,470 MILES.

governed the lateral play on the track accordingly.

All our engines have swinging bolsters on engine trucks, and we allow 1/8-inch play between truck boxes and hub of wheel—1/4-inch over all.

The driving boxes we allow 3/32-inch from face of box to hub of wheel—3/16-inch over all.

I have selected a ten-wheel engine and a consolidation engine that have been in service fifteen months *since last turning*, to show the condition of the flanges at the present time; also a ten-wheel engine that had a *blind tire on* main wheel when we received it. We have turned the tires twice since we received the engine, and



TIRE SECTIONS FROM ENGINE 190; CONSOLIDATION; IN SERVICE SINCE LAST TURNING, FIFTEEN MONTHS, MAKING 41,950 MILES.

have formed the flanges as shown on that sketch.

In conclusion, will say that our track is well looked after as regards gage and elevation. With this point assured, and the lateral play as shown, we have not as yet seen the necessity of a blind tire on locomotive drivers.

D. BROWN, M. M.,
D., L. & W. R.R.

Scranton, Pa.

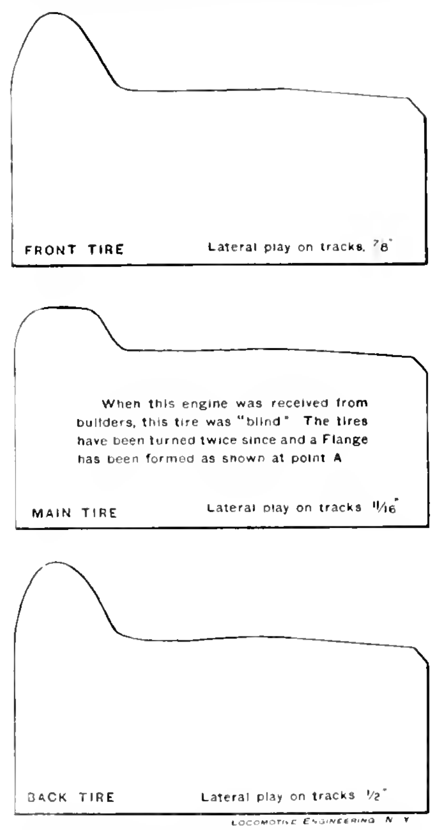
Measurement of Heating Surface.

Editors:

In looking over your interesting monthly for August, I noticed, on page 498, an article called "Measurement of Heating Surfaces."

It seems to me this matter could be more satisfactorily explained by a clear definition of the terms "heating surface" and "fire surface."

In this article, for instance, the term is applied to the interior diameter of the tubes, and I think they should be called the "heated surfaces," as, of course, the surface is heated, while the opposite side of the tubes, imparting its heat, as it does,



TIRE SECTIONS FROM ENGINE 16; TEN-WHEELED ENGINE.

to the water, seems to me should be termed "heating surfaces," or surfaces that heat, as it is an active agent.

Webster defines "heating surface" and "fire surface" as one and the same thing. This seems to one, who is, perhaps, a novice on these subjects, a misnomer. The commonly accepted interpretation seems to me as follows: A "fire surface" is the portion of the boiler that is acted on immediately by the fire, or that part with

which the fuel is in actual contact, and on which the rays of heat (and light) act directly. I think it would be well for you to explain also, in this connection, the term "boiler surface."

I would like your views on this subject, as I am about putting on the market what is now called a water-tube boiler. My first invention in this line, patented November 24, 1863, I termed a pipe boiler. I submit, is not this the proper term to be used?

WM. C. BAKER.

New York, Aug. 10, 1895.

[Mr. Baker, the veteran car-heating expert, has taken up a subject which ought to receive immediate attention from the engineering societies of this country. His distinction of "heating surface" and "fire surface" makes plain a matter about which there has been confusion that led to some boilers having their heating surface overrated and others underrated.—EDS.]

New Shops of the O. Ry. & N. Co., at Starbuck, Wash.

Editors:

The O. Ry. & N. Co. have recently moved into their new division shops at Starbuck, Wash. They are as near a modern and model shop for the purpose erected for, as can be found in the Far West.

The roundhouse, machine shop, power house, store room or supply house are all brick, and well provided for light by many windows; the blacksmith and boiler shop, coal bunkers, sand house and car repairers' shed are frame.

The roundhouse is 75 ft. long, 29 ft. high next to the turntable and 25 ft. high at the other end. It has fifteen pits; each pit is 56 ft. long, 48 in. wide and 24 in. deep at the front end and 30 in. at the back end, so there is plenty of fall for water in boiler washing. The pits are all connected by a 12-in. sewer; at the back end of each pit is a catch basin 15 in. below the bottom of each sewer pipe the full width of pit and covered with a grate, so all scales fall into basin and not into sewer pipe and stop that up.

Two of the pits are so constructed that they can be used as drop pits. Engines head in and stop under a telescope jack.

The sides and bottom of all pits are concreted. The roundhouse is heated by steam pipes in the pits, from engines in the roundhouse or from the stationary boiler.

There is a line of $2\frac{1}{2}$-in. pipe through the roundhouse nearly over the steam domes of the engines; the end of pipe extends through the sides of roundhouse; there is a smaller pipe that connects with this between each pit with a Jenkins valve on it. In the steam dome of each engine there is another valve and connection, so when steam is to be blown off a boiler, a hose is connected with valve in dome and valve on pipe between pits, and steam is blown off through pipe at end of roundhouse, doing away with that noise of steam blowing off through whistle with a "gag" on it. Where blower pipe connects with the smokebox on each engine is a connection same as in dome. The $2\frac{1}{2}$-in. line of pipe through roundhouse is connected with steam dome of stationary boiler, so hose can be connected to pipe between pits, and blower pipe and steam from stationary boiler used for a blower. The line of $2\frac{1}{2}$-in. pipe is so arranged that steam can be taken from some engine in roundhouse to run pump when stationary boiler is to be washed out.

There are two windows in front of each pit, and five at each end of roundhouse, with transom 3 ft. high over each door and the full width of doors, and windows in each door, giving the roundhouse plenty of light. In the roundhouse are two wash sinks, with hot and cold water for the use of enginemen.

The machine shop is 40x100 ft., with one track through it; it has one pit 30 ft. long, and same width and depth as pits in roundhouse. In one corner of machine shop is a tool room, well supplied with a good assortment of taps, dies, reamers, and other tools for doing running repairs, as these shops were intended for. There is one planer 20x30 in., one shaper, one 30-in. drill press, one 20-in. drill press, one 32-in. swing lathe, two 20-in. swing lathes and one 16-in. swing lathe, and one belt cutter and nut-tapping machine.

In the power-house is the stationary boiler, a locomotive boiler, 19 ft. long and 49 in. diameter, that furnishes steam for the 10 x 16-in. stationary engine; a No. 8 Blake pump and steam for heating roundhouse, machine shop and store room, as all buildings are heated by steam. In the power-house are three wash sinks, with hot and cold water for the use of the shop men. The floor in power-house is concreted; all drain pipes were laid before floor was put down, so pipes are not seen. The coal can be unloaded from cars into coal-bin in power-house.

The blacksmith forges are supplied with blast from a blower in the power-house. The boiler shop is supplied with shears, rolls and punch.

The water system is the very best; the tank is filled by gravity, and from the tank water flows through a line of pipe on the outside of the buildings for fire protection, and through all the buildings; or water can be taken from the tank or well and pumped through all the pipes, or taken from the well and pumped into the tank. There is an electric call bell near each hydrant in roundhouse, and signals to notify engineer in power-house when boiler is to be washed out or cooled off.

The store or supply house is 20 x 30 feet, and is set up high, so supplies can be unloaded from cars on to platform and store-room, where all casting and heavy material is kept. Under the store-room is the oil cellar, with six oil tanks with pipes from the top of each tank to edge of platform near track, so oil can be unloaded from cars to tanks in cellar.

Last, but not least, are our bath rooms; the employés here believe that "Cleanliness is next to godliness," especially so in the summer months, when the mercury crawls up to the 114 and 116 degree notch, so the company very generously donated a building, with all the hot and cold water wanted. The employés passed the hat around among themselves, with the result that porcelain bath tubs, with linen and everything necessary, was procured; so now we have two tubs that we can enjoy to our full.

These shops were begun when the U. P. system had control of this road, but completed under the supervision of Mr. J. F. Graham, Gen. M. M., and Mr. H. N. Webber, Div. M. M., who was here under the U. P. management.

GEO. K. WENTWORTH,
Starbuck, Wash. Shop Foreman.

Wants Sand Pipes in Front of Truck Wheels.

Editors:

In your July, 1895, issue of LOCOMOTIVE ENGINEERING there is an article entitled "Tests Made to Determine the Stopping Power of Engine, Reversed, With and Without the Use of Air Brakes."

According to the tests made by Mr. Thomas, it would seem that the best re-

sults were obtained when the sand on the rails had been used before. Now, if this is the case, I should think it would be better to put the sand pipe on the engine in front of the truck wheels instead of the drivers, for then the sand would have been ground over the rails by the truck wheels, so the drivers would not get the sand fresh. I would like the opinion of some of the readers of your valuable paper on this subject. CLARENCE ABEL.

Waco, Tex.

[We think that the best lesson of the experiments referred to by our correspondent is, that only the exact quantity of sand required should be supplied. This can be regulated by using any of the sanding devices now upon the market.—EDS.]

An Ottoman Railway.

In his travels in the East, Cy Warman found, as a rule, that the railroads were in a most dilapidated condition, comparing very unfavorably with the worst to be found in this country. He met with one or two exceptions. Writing of his arrival at Smyrna, he said: "I went ashore here and found a real railroad. The Ottoman Railway, whose headquarters are at Smyrna, was the first in Asia Minor, and was begun by the English company, which continues to do business, thirty-six years ago. William Shotton, the locomotive superintendent, showed us through the shops and buildings. One does not need to be told that this property is managed by an English company. I saw here the neatest, cleanest shops that I have ever seen in any country. There were in the car shops some carriages just completed, designed and built by native workmen who had learned the business with the company, and I have not seen such artistic cars in England or France. Mr. Shotton explained to me that they found it necessary to ask an applicant his religion before employing him, so as to keep the Greeks and Catholics about equally divided; otherwise the fraction in the majority would lord it over the weaker band, to the detriment of the service. An occasional Mohammedan made no difference, but the Greeks and Catholics have it 'in' for each other.

"The Ottoman Railway Company has 350 miles of good railroad, and hope some day to be able to continue across to Bagdad, though it is hinted by people not interested that the Sultan's government favors the sleepy German company, to the embarrassment of the Smyrna people, who have done so much for the development of this marvelously blessed section."

Agriculture in Great Britain is suffering from the competition of America and other countries. A means of partial relief recommended is the building of cheap railways to transport agricultural products to market at low rates. Influential public men in England are making the advocacy of this scheme a hobby.

Improved Fire Kindlers.

The report on Locomotive Fire Kindlers submitted to the last Master Mechanics' Convention shows that within the last two years wonderful progress has been made in changing from the old-fashioned, dangerous, dirty practice of kindling fires with wood to methods that are in every way superior. The Leslie kindler, which uses oil in a perfectly safe way, is now in use in nearly one thousand engine-house stalls, and the Smith kindler is making steady progress into popularity. The impetus from investigating improved methods of kindling locomotive fires has done much to induce railroad companies to try departure from the wood pile. There is no doubt that the use of oil for kindling fires is cheaper and safer than wood, and it only remains for continued success with this method to bring into line the companies who are holding on to the old practice through force of habit.

A fire kindler which appears to be much less expensive than wood, and placates the prejudices of those who are opposed to the use of oil, is the Le Bel, which is largely in use on the Canadian Pacific, and is used in a limited way on the Fitchburg and the Vermont Central railroads. This kindler is made into brickets, and is composed of resin, coal oil and sawdust. Those who have had experience with this kindler speak highly of its convenience and efficiency. Speaking of this kindler, Mr. R. Atkinson, mechanical superintendent of the Canadian Pacific, said:

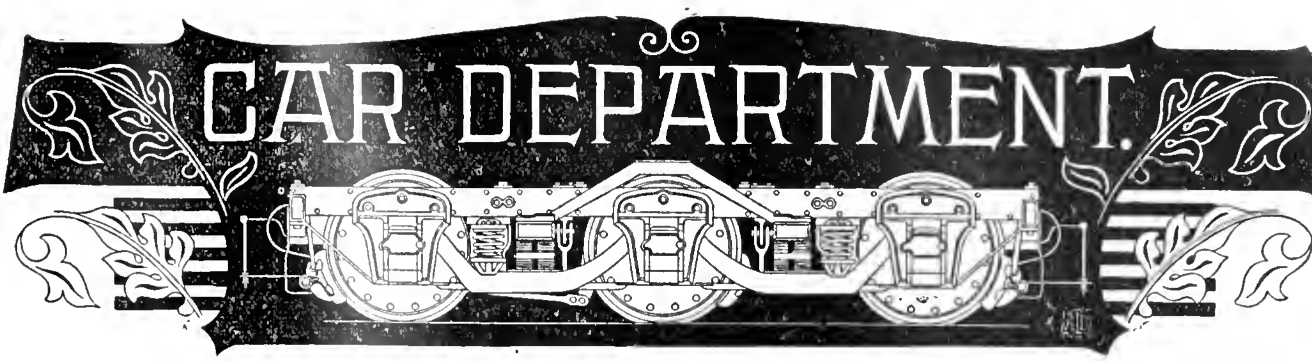
"I have tried the Le Bel kindler and it has worked well. It did not work well at first. We did not know how to use it. We commenced in the ordinary way to put the kindler below the coal. We afterwards found out it would be better to make a mound of the coal and put the kindler on the top—being of a resinous nature it melts and runs down in the body of the coal. I conducted a test between two sister engines, one with wood and one with the Le Bel kindler; cold water in each case; engines in the same condition so far as we could ascertain; and the assertion was made that we should debit the Le Bel kindler with the cost of more coal as an off-set to the heat of the wood in the other case; but we found in the course of the experiments that we had to put the same amount of coal on in each case; in fact, that it was not a question of raising steam—it was a question of getting a body of fire ready to go in service. I put 600 pounds of coal with five sticks of the Le Bel kindler in the firebox of an eight-wheel engine. I did not put all the coal in at one time—300 pounds to begin with, and afterwards the balance—and I think I have here the time of raising steam. The first steam showed in 53 minutes, and 70 pounds of steam in 78 minutes. When the engine was loaded up with wood immediately afterwards, I used 95 pounds of the best dry pine scantlings that we had, without any sap wood or bark, and the first steam showed in 37 minutes, and 70 pounds in 57 minutes. But the fire on which I had put only 500 instead of 600 pounds of coal, in the case of the Le Bel kindler, was more thoroughly burned through at that time, and, therefore, the next increase of steam up to 120 pounds was got more slowly, and when I got 120 pounds of steam with the Le Bel kindler I had a fire something like 3 inches thick and ready to go out with the train, and, in fact, it went out as soon as I could let it go. The other had to wait while I put another 100 pounds of coal on before she was ready to go. So that we consider that the number of sticks of kindler used was the total cost required.

"I understand that they are selling that kindler at a cent a stick. I must say it is very handy. The locomotive foreman can keep his box of kindler in his office, and hand out the number of sticks required. There is no loss of any kind, and we might almost say no fire risk, because you keep the box in a corner of the office and there is only the ordinary risk of an office fire. To start it, we put on a little oily waste generally. You need not do so, but we have oily waste around and might as well burn it. There is a very great gain in that we have such a small amount of carriage to pay for. We have so many hundreds of miles where there is not a stick of wood, and the wood has to be hauled there, and we can haul a cartload of kindler for probably about one-sixtieth or one one-hundredth of what it would cost to haul the necessary amount of wood to fire the same number of engines."

It would seem from this that fires can be kindled for five or six cents each, which is a very great saving compared with wood. Oil costs about two cents for each engine fired up, but there is more coal used than there is when wood is employed. Both systems indicate a decided improvement over wood.

The objection has been raised to these improved methods that they may be harder on fireboxes and cause more cracking of sheets and breakage of stay-bolts. The matter is worthy of investigation, but we question if there is anything to it. Those who have been wedded to old practices generally imagine difficulties in the way of change, and it seems to us that the objections to the improved fire kindler come principally from conservative impulses.

One of our correspondents in Brazil writes us that the sixty locomotives shipped by the Brooks Locomotive Works to that country early in the year are now all in service on the Brazilian Central Railway. The putting of the engines in running order was done under the supervision of Mr. Lewis Gleason, representative of the Brooks Locomotive Works. The officers of the Brazilian Central and the men handling the engines all speak very favorably about their performance.



Conducted by Orville H. Reynolds, M. E.

A Few Minutes With the Lever.

"O, wad some power the giftie gie us" to tell why the mechanical device we call the lever should be divided into three kinds! It certainly is not clear. Perhaps its purpose was to lead to the belief that a different law governed each—else why the classification? That is about what the effect is, whatever the cause, leading up to this entangler of the young idea (and old one, too) when learning to shoot.

There can be only one formula for the calculation of leverage; masquerade with it in any and all shapes we will, it is the same old formula. Let us analyze this thing and see if it is not so. Given a rigid bar having a motion in one plane only, about a certain point, known as the fulcrum or origin of moments, around which the force and resistance turn, we have the lever. In mechanics, *a moment is the product of a force multiplied by a distance, and is the tendency to cause motion about an axis.* For a lever to be in equilibrium, the moment of force must equal the moment of resistance; or, in other words, the force multiplied by its distance from the fulcrum must be equal to the resistance multiplied by its distance from the same point—and this is all the formula needed for any lever. The distance is always taken perpendicular to the direction of the force; that is, the greatest moment is found when the force is at right angles with a line passing through the fulcrum; and this determines the effective length of the lever arm, whatever the shape of lever, whether straight, bent or curved.

The origin of these moments is at the fulcrum or point about which the lever turns, and it is the failure to understand this fact that usually brings confusion. It is the essence of the whole subject; and without a clear conception of its importance, it is not plain how a division of levers into classes can pave the way to an intelligent handling of the problems involved in their use.

Since any formula is simply a rule for the solution of a problem, the less there is to it, consistent with an understanding of the principles on which it is based, the more lasting will be the lesson and the greater good to be derived from a knowledge of it. To illustrate: Let Fig. 1 represent a lever in which the forces are effective at right angles to a line drawn through the fulcrum. If now the force, 100 pounds, be multiplied by its perpendicular distance, 10 inches or feet, from the fulcrum, there will be a moment equal to $100 \times 10 = 1{,}000$ inch or foot pounds tending to turn the lever about the fulcrum. To resist this turning tendency, the shorter lever arm must have a number of pounds which will, when multiplied by 5, give a moment equal to that on opposite end of lever. This is

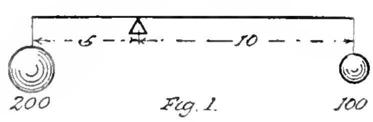


Fig. 1.

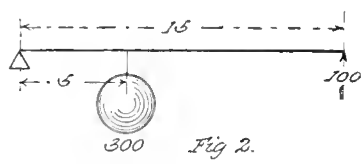


Fig. 2.

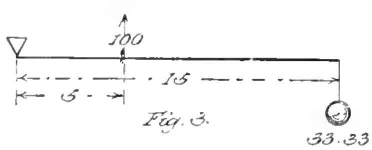


Fig. 3.

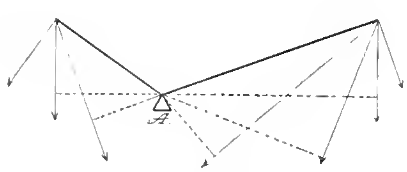


Fig. 4.

found by dividing 1,000 by 5, and the force is, therefore, 200 pounds. The proof that these forces are in equilibrium is had by multiplying each force in pounds by its perpendicular distance from the fulcrum or origin of moments. It is found that $100 \times 10 = 1{,}000$, and $200 \times 5 = 1{,}000$, thus showing desired equality of moments.

Taking a force of 100 pounds at the outer end of a lever like Fig. 2, and placing the fulcrum at opposite end, the moment of the force is found to be $100 \times 15 = 1{,}500$ inch or foot pounds, and the moment of resistance $= 300 \times 5 = 1{,}500$ inch or foot pounds also.

Leaving the fulcrum at the end, as in Fig. 2, with a lever of same length, and applying the force as in Fig. 3, we find the moment of the force to be equal to $100 \times 5 = 500$, and the resisting moment is therefore equal to $33.33 \times 15 = 500$ nearly. In all these diagrams it is seen that the forces are inversely as the length of their lever arms. Fig. 4 will show graphically that the shortest distance measured at right angles from the fulcrum *A* to lines representing the direction of the forces, must give the correct length of the lever arms; the arrows showing direction of forces, and the dotted lines the length of lever. From which it is seen that the length is of no material consequence as compared with the direction of forces.

Attention is particularly called to Fig. 4 in its importance as affecting a braking system on a car. It is evident from this that the levers can be placed at such an angle as will materially change the braking power calculated on. This condition of things has been found on many roads, and the search need not be exhaustive to find it on others.

Our moss-covered friends, the "three kinds," will probably remain at the old stand (until the text-books are revised), and continue to pass out fog to the unwary who do not realize that the principle of the lever, entering as it does into every possible form of construction, can be best mastered by taking into confidence at once a fundamental formula that will develop the reasoning faculties, and thus avoid rooting in the ashes of disappointment.

Improvements Needed on Air-Brake Attachments.

The impression that there are some things about the braking system of a car that are yet open to improvement, is forced into conviction by the very groggy appearance of some metal brake beams, their heads hanging as if in shame for their part in contributing so inexcusably to the cross-eyed effect always present in any device not coming fully up to expectations. These beams all have a certificate of character in the shape of a carefully prepared table of stresses they have stood up under, with their corresponding deflections, and showing a strength combined with lightness that excites admiration; but when they are hung in position, the pleasant memories of their guaranteed capacity vanish, and are

replaced by the feeling that something is wanting, and that, while they are a long way in advance of the old practice in point of rigidity, they are not entitled to the stamp of approval until they are suspended so as to allow the shoes to have a correct relation with the wheel tread.

Their lop-sided tendency is what offends the optic nerves. No one likes to see a brake shoe worn away at the top by useless friction on the wheel, when the bottom of shoe lacks contact with the wheel by two inches or more. It is true that there is provision made in many cases of this kind, to insure, by means of a separate suspension, the hanging of shoes concentric with the wheel; but is it wise to increase the complication and cost, to remedy what is plainly a faulty design, in that it must be tied to position?

What is needed here to improve a really good thing, is simply to place the points of suspension on brake heads so that they will be in a line passing through the center of gravity of the beam and all its parts. This has been recognized as the proper thing to do, as is shown by the position of hanger holes in all the beams, they being found as close to the shoe as possible, to obtain the desired balance, and only deterred from further movement by reaching the key, at which point a stop had to be made, and any further improvement was to be had only by altering the overhang of truss. A beam is easily put in balance by designing a truss with that end in view; it is therefore a reasonable inference that the major portion of these metal beams were designed with special reference to loads, and that suspension was of secondary consideration.

The M. C. B. report on Metal Beams, in 1889, made mention of one beam only, in all those tested, as having a correct balance. In the past six years there is but little improvement noted in this respect—in fact, but one other beam fulfilling the conditions; but that the need for it exists, the shoes that are scrapped with a well-defined cusp at upper end bear the strongest evidence.

In the matter of brake levers, the reformers are at work in the direction of standard proportions—a need which was never more apparent than at the present time. No longer ago than 1893, the M. C. B. Association adopted a standard leverage for freight cars, and furnished all dimensions for width and thickness of levers for a brake-beam load of 7,500 pounds. Ready with a full meed of praise for the good accomplished by that move, we incline to the belief that the work was left incomplete, and that something more than an outline of a principle is required to put this thing in self-sustaining channels—for this reason: Limiting figures, to cover all possible conditions, have been given us by the association in every important instance where a standard has been placed on record. Why has this business-like procedure been omitted in this case, where the need for it appealed so loudly for action? It is not enough to say, "We have furnished you a standard arrangement—now design the leverage to suit your car," for a standard would then be as far in the future as at present, because the practice of every road would be a law unto itself, just as of old. What is needed here, then, is a braking system gotten out on the lines of the adopted standard, but having a leverage suitable for different weights of cars, and providing for brake-beam loads from 3,500 to 7,500 pounds.

What is next needed is to have these levers designed without their usual springy features—with as little deflection as possible, for it is no secret that piston travel is not wholly dependent on the wear of brake shoes.

Until the levers are made stiff enough to transmit their forces without reaching their elastic limit, the automatic brake will not be up to the splendid efficiency it is known to be capable of. Limber levers are a handicap that should be made to move on—they have no place in brake economy. These are some of the pressing needs that only lack the attention and seal of the association to make brake reformers register in fresher fields and pastures new.

There is an active demand among Southern railroads at present for the renting of second-hand cars which can be used in moving the crops. Second-hand flat cars are also in demand to be used for construction purposes. The indications are that those wanting second-hand cars will have to purchase them outright, and if they do not attend to this promptly there will be no second-hand cars left either for renting or purchasing. The dealers who hold the cars will win in a waiting game.

The National Lead Co., New York, have issued a pamphlet entitled "Concerning Babbitt or Anti-Friction Metals." It deals with a subject which every man connected with the running of machinery ought to be familiar with. If knowledge concerning the properties and ingredients of soft metals was more wide-spread and accurate than it is, there would be fewer hot bearings, and less money would be paid out for metal that had nothing to recommend it beyond a high-sounding name. Send for this pamphlet.

The Trojan car coupler has been specified on 1,000 cars ordered by the Beach Creek Railroad, and on 275 cars ordered by the Intercolonial Railway of Canada.

We have received an illustrated pamphlet describing the Willis planimeter, one of the most ingenious instruments we have ever seen. Steam engineers who have to figure up the horse-power of indicator diagrams ought to send for this pamphlet. It can be got from E. J. Willis, Richmond, Va.

An American on Australasian Railways.

Major Pangborn, president of the World's Fair Transportation Commission, has been interviewed by the representative of the *Auckland News*, in Sydney. Concerning the New Zealand railways, he says they present the most unique and interesting situation the commission have yet come upon, and he can hardly dignify the railways there by describing them as under any management whatever. The generally accepted principle of railway control must be something of military precision and discipline among the employés. In New Zealand the condition is the opposite. He condemns co-operative construction of railways, believing that it costs from 50 to 60 per cent. more than by contract in any other country. He considered the surveys most extraordinary. Flying surveys seem to be accepted instead of exhaustive permanent ones. Continuing, he says the country is certainly a fine one, with great possibilities, and its natural advantages are incalculable.

Speaking generally, the permanent way is well kept, and the locomotives and rolling stock are well found. He believes that the men in New Zealand are competent to manage the railways if given an opportunity, but at present they are simply a lot of clerks, with power so restricted as to have no power at all. As far as the system is concerned, there is a striking absence of modern appliances for safety brakes, and the signal system is a poor one. Commenting on New South Wales lines, he says he has seen no finer system since leaving London.

The last report of the Postmaster General has some interesting figures concerning the volume of Uncle Sam's postal business for the average day of the year. The following are a few of the daily items: "Number of miles post route run, 1,100,000; number of stamps manufactured, 8,300,000; number of envelopes manufactured, 1,800,000; number of postal cards manufactured, 1,500,000; number of pieces mailed, 15,700,000; number of letters mailed, 7,400,000; number of pieces of mail matter distributed and redistributed by postal clerks, 27,500,000; number of pieces handled in dead letter office, 24,000; daily transaction in money orders, $1,000,000; daily expenses, $231,100."

There is talk of a combination among the steel-tire makers, for the purpose of stiffening prices. Some of the concerns making tires need more to raise the quality of their material than to raise the price.

The Tyler Tube and Pipe Co.'s Algerite knobbled hammered charcoal-iron waterarch tubes are to be used in the locomotives now building for the L. S. & M. S. Ry.

A Ride On a Single-Driver Locomotive.

More years ago than I care to figure up, when I first reached the proud distinction of keeping the firebox of a locomotive supplied with the steam-making combustible, the greater part of the passenger engines of my acquaintance had single drivers. I have always had a great regard for the easy-riding qualities of that style of engine, and even greater respect for its capacity to hold to the track under difficulties.

A slightly exciting incident of my own early railway experience left upon my mind a lasting regard for the tracking qualities of the small single-driver engines of the time. I was firing for Charlie Gregory—peace be to his ashes!—who loved the flowing bowl not wisely, but too well. Ours was a pilot or assisting engine, and we had gone about fifty miles helping the fast mail. Charlie imbibed so freely before starting that he lay on the foot plate all the way. In returning light we had to back up, and the cold night air gradually brought Charlie to the sitting-up condition. A good-natured fellow when sober, he was a fiend in his cups. As soon as he got up I knew he would find fault with something, and this time it was that I was running the engine too slow. He grabbed the throttle lever, and said that he did not intend to be all night in getting home. It happened that we were just entering upon the descent of the steepest grade on the road, which was three or four miles long, with a number of sharp curves. He opened the throttle wide, and kept it there. The drivers were seven feet diameter, and the engine was noted for her running qualities. We went to the bottom like a flash, and on every curve we struck the engine seemed to turn on her side, but somehow she held to the rails. It was an experience that gave one confidence in the safety of single-driver locomotives.

When I was invited by Mr. S. M. Vauclain to take a ride on the new Philadelphia & Reading single-driver engine, I very readily accepted the offer for the "days o' auld lang syne." On getting to Jersey City, where I found the engine already attached to a six-car train of the heavy Blue Line, I looked at the load and examined the engine, and felt, from past experience, that there would be some difficulty in getting the train into speed. The old-time single-driver engines would run, once they got the train going, but they were very slow on the start.

The engine attracted great attention. Crowds of people stood round watching the latest curiosity, and from the remarks heard on the platform, the belief prevailed that she was a hybrid between a locomotive and an electric motor.

The cars weighed at the least estimate about 120 tons. When the starting time came I climbed up into the cab on the top of the boiler. The engineer had everything ready, and when the signal was given, pulled out without slip or jerk. This is made possible by use of the air sanding device. There is a long yard to be traversed in the start, and the presumption is that the maximum speed was not attempted there; but the engine covered the first six miles in seven and a half minutes. That settled in my mind the question about single-driver engines being slow in starting.

After I had ceased watching the mile posts to make sure of the speed, I settled down to watch the working of the engine. The first impression received was: "How splendidly she rides!" A train of six heavy parlor cars is not kept moving at a speed of 60 miles an hour without great expenditure of power. The easy maintenance of speed with this engine was due in a great measure to the fine steaming qualities. All throughout the run of 92 miles, the steam gage showed a constant pressure close on the popping point of 200 pounds to the square inch. This was the more surprising, considering the character of the coal. I examined it carefully on the tender, and found it to be anthracite slack—not the clean, grain-looking coal known as pea, but a mixture of pea and dust. The Wootten firebox, with its large grate area, makes the burning of such coal a possibility on a high-speed locomotive. With the ordinary firebox and sharp exhaust, this coal would pass through the tubes almost as fast as it could be thrown in; but with this large firebox and the soft exhaust characteristic of a compound locomotive, the finest particles of carbon are utilized to their fullest extent.

The run of 92 miles in two hours and six minutes, with seven stops, ought not to involve exceptionally fast running, since the engineers are instructed to make the speed as nearly uniform as possible. But as we go along through the crowded towns and villages on the route, we soon realize how stretches of speed of about 70 miles an hour or over are necessary to make the time. There is a constant call to slow up at stations where crowds of passengers are loading upon local trains. A system of overhead bridges for passengers to cross the track on, and fences to prevent them from crossing on the level, would aid greatly in maintaining high speed for through trains. The Jersey Central and Philadelphia & Reading have excellent track in the line between New York & Philadelphia, but the facilities for keeping people off the track might be greatly improved. The Pennsylvania Railroad is much better provided in this respect.

Owing to various causes for the reduction of speed, an unchecked speed was seldom maintained more than ten miles at a stretch, and the delays had to be made up for by fast running where that could be done. The engineer protested that he was prohibited from running fast, but I noted mile after mile passed in fifty seconds, and one mile made in forty-six seconds. The letter speed is over seventy-eight miles an hour.

Everybody who has ridden on locomotives running at speed above sixty miles an hour is familiar with a vertical jar which makes most engines ride badly. This is due to the upward blow of the counterbalance. This single-driver engine is remarkably free from the upward jar, which is certain testimony that the counterbalancing has been well adjusted.

We left Jersey City at 6:12 P. M., and had only got over about half the distance when it became dark. Then we could see in its strongest aspect the safety and comfort that comes from the use of block signals. As stations were approached the novice was struck with the confusion of head lights, tail lights, electric lights and all varieties of lights, many of them colored; but the engineer looked for a particular spot, and if the light there did not indicate danger, he kept the train going without hesitation. Rushing along in the front of a train of this kind gives a most impressive lesson of the need for the very best of signals—signals which can make no mistake of indicating safety when the track is blocked by any obstruction.

The train has darted through many junction points, through alleys of cars and through myriads of signals; it has twisted round sharp curves, and screamed through crowded stations. Cuttings and embankments and tunnels have been traversed at the speed of a hurricane, and I realize that the engineer carries a burden of responsibilities that I had never dreamed of, although I had spent twelve years on the footboard. We roll into Philadelphia on time, and I reflect upon making the trip on that engine as the man did who made a meal of crow. It can be done, but one does not hanker after it as a regular thing.

A. S.

High Claims for a Feed-Water Heater.

There is a new feed-water heater and purifier put on the market by Brancher Bros., Danville, Ill. The claims for the heater are that it satisfies those who want the water hot, the plates cool, the steam dry, the boiler clean. It consists of a cylinder with enlarged conic base placed on top of the boiler. The feed water is received in a series of saucers, then drops into a conical cup, from thence it passes into the boiler. The proprietors writing to us about the heater, which is not a heater as that term is generally understood, says:

"Our invention takes advantage of the forces acting in the artificial ice machine, by which we compel an increased absorption of heat from the fuel in the steam boiler, making more steam at higher pressure than is possible when feeding below the water line and below the boiling point. It will save at least 20 per cent. of the fuel on locomotives and 50 per cent. of repairs, besides increasing their power by making steam at a uniform and higher pressure than is possible by the old way. A locomotive will be on the road a greater propor-

tion of the time, resulting in increased mileage as well as increased tonnage per mile. Also saves a large part of the steam usually blown out through safety valve, and avoids the necessity of throwing furnace doors open when making a stop of a few minutes to prevent waste of steam. All told in a few words, its value is calculated to be at the very least $1,000 per year on each locomotive."

These claims are not what one would call too modest. We never before heard of any law of nature that made water boil or evaporate more readily because it goes in at the top instead of at the side of a boiler. The people who have watched steam phenomena for two or three thousand years must all have overlooked this. But what is more surprising is that the people connected with the Illinois Central Railroad did not notice the advantage there was in admitting water at the top of the boiler. They used a dome placed on the top of the boiler as a feed-water purifier for many years on all their locomotives, and it was abandoned as useless.

The Little Giant feed-water heater and purifier may be a good purifier, but as a saver of heat the claims do not hold water.

Facts Found by Etching Metals.

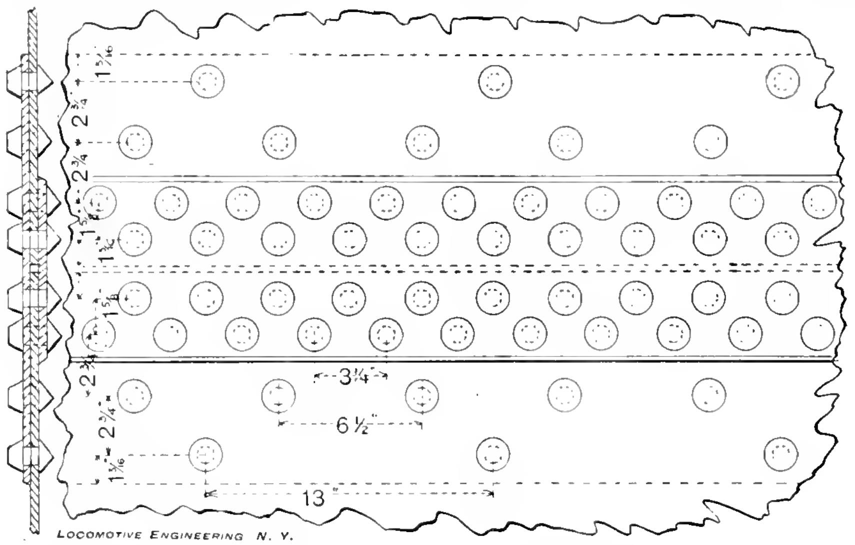
The practice which some railroad men have adopted of etching iron and steel, to find out the structure of the material, is bringing out interesting facts which physical and chemical tests failed to supply. We have received from the Chicago, Milwaukee & St. Paul, etchings of boiler-tube ends, which show plainly that certain makers of boiler tubes put a layer of iron outside and steel inside. This, of course, is sold as first-class iron tube.

The Big Four people have just made a curious discovery of how some brands of stay-bolt iron are made to stand the tensile strain and elongation tests required for good stay-bolt iron. Mr. Wm. Garstang, superintendent of motive power, and Mr. A. T. Lawes, mechanical engineer, came to suspect that there was something wrong with the stay-bolt iron supplied, so the latter official etched a longitudinal section of the iron, and found that it contained strips of steel which had been worked in. The *Railway Review* states that when this etching was submitted to a manufacturer of iron, with the question if this was a common occurrence, the admission came out that it was. It is done to save labor, so the manufacturer said. On the same ground, all inferior articles are produced, but it has seldom been found in the history of fraudulent goods that the deception was so skillfully covered up.

The test of etching can be made at very small expense, and does not call for much skill. A railroad company does not require a laboratory to make etching tests. Any foreman or storekeeper of intelligence will soon become expert at doing the work. There is a practice among some unscrupulous manufacturers of sending to railroads having no test department, material which has been rejected by roads having laboratories. A systematic practice of etching would help to prevent frauds of this character.

Improved Boiler Seam.

The annexed engraving shows the Fourness improved longitudinal boiler seam. This is a butt joint; none other should be used for boilers carrying high pressures. The improvement consists of increasing the width of the inside strap 5½ inches, and adding the outside rows of holes 13 inches apart, leaving the weakest part through this row, and increasing the strength 6¼ per cent. over the old seam, when the weakest part was through the row of holes spaced 6½ inches apart, and had a percentage of strength to the solid metal of only 87½ per cent.



Mr. Fourness says: "I submitted this seam to the Hartford Steam Boiler Inspection & Insurance Co., to ascertain if it had been in use previously, to their knowledge, and they sent word that a similar seam, but with three rows of rivets exposed to single shear (mine has but two), was in use in a pumping station at Minneapolis, Minn.; consequently, if any one wants a good strong seam, this is the one to use, as I believe this is about as strong as it is possible to get one. I do not believe it is patented, and the cost is but very little over the old butt seam of 87½ per cent. of strength."

Circulating Sheets in Water Leg.

In a report on "Bulging of Firebox Sheets," submitted to the last Master Mechanics' Convention, the following paragraph appears: "I would make the water space of a firebox wider than at present, and increase its width at top of firebox not less than ¼ inch to the foot. In 1831 a patent was granted for a circulator for steam boilers, which consists of a plate dividing the inside and outside of the water leg. The theory of the action of this plate is: The hot water rises by virtue of its specific gravity to the surface, and its place is taken by water relatively colder descending on the outside side of the circulating plate. There is every reason for believing that the circulation of the water would be improved by such a device in the water leg of a boiler. I have no information of how the device worked in practice, nor do I know if it ever was applied to a locomotive boiler, but as the patent has long since expired it would cost nothing to use it, and it is a possible solution of the question raised about the bulging of firebox sheets."

We have a little more knowledge of this subject than the correspondent of the Master Mechanics' Committee, and we can inform all interested that circulating sheets were at many times applied to American locomotives, and that patents for the "valuable invention" were granted in this country for the circulating plate long after Perkins' patent expired. That, however, is nothing extraordinary. The circulating plate has not only been applied frequently to locomotive fireboxes in the past, but several locomotive builders have put it into fireboxes within the past year.

The theory of its action is highly philosophical, and is convincing to the ordinary mind that material economy would result from its use. We examined a glass boiler exhibited at the exposition of railway appliances at Chicago in 1883, which showed the water circulating with fierce rapidity, just as theory made out it would do. We had been a warm believer in the use of circulating plates since we watched that glass model until lately, when particulars given us about a test on a larger scale destroyed our faith.

Ten or twelve years ago the Rhode Island Locomotive Works were building some engines for the New York, Providence & Boston. The engines were all made from the same templates. There was in the locomotive works at that time an official who was a firm believer in the economy

and value of circulating plates in the water leg, and he prevailed upon the foreman boiler-maker to put them in one engine without letting anybody know. He consented, and the work was done secretly at night. The engine was the "J. B. Gardner," and she is still in service. The official who believed in the plates made a hobby of watching that engine, to note the great results anticipated. The water used is so pure that an engine can run for months without washing out, and there was no fear that mud would impede the circulation. For months that engine was watched and compared with the performance of others. She never steamed better than the other engines, and the performance sheets from year to year indicated that she burned about the same amount of fuel, and there has never been any indication that the side sheets would last longer than those of other fireboxes.

The Latest High-Speed Locomotive.

In 1881 the Grant Locomotive Works built a locomotive designed by Mr. Eugene Fontaine, of Detroit, which excited great attention for a few years owing to the radical departure from established practice in designing locomotives. Fontaine built his engine with the driving-wheels above the boiler, so arranged that their tread pressed upon and transmitted motion to the carrying wheels by the frictional contact.

The reasons given by the designer for building this form of an engine were: "The question of faster speed in railroad travel is one that is now attracting attention on the part of the public, who demand it, and of the railroads, who are anxious to meet the demand.

"It is well known that to increase speed in locomotives, as now used, beyond a certain rate, can only be done by an increase of steam pressure, which can only be obtained by increased expenditure of fuel, and such expense increases in a tenfold ratio to the increased rate of speed attained, to say nothing about the additional strain upon the boiler."

To overcome these imaginary deficiencies the locomotive with two-story driving-wheels was built and put in service. There was considerable discussion in the scientific press about the claims of the inventor, but there were very few engineers who believed that any advantage of speed or economy could be secured by the wheel arrangement adopted. Their judgment was vindicated by the results of practical service. The engine was tried on all kinds of trains, but proved inferior in every respect to the ordinary engines of the same capacity. The engine was a curiosity in a variety of roundhouses for a few years. There was always something needed to make her work satisfactorily. After many changes, the proper one was made when she was rebuilt into an ordinary eight-wheel engine.

It might be supposed that the Fontaine experiment would deter others from trying the expensive blunder again; but when an amateur gets seized with a malady for designing a locomotive of an entirely new pattern, he generally produces something startling, as the "James Toleman" and the "Raub Central Power" monstrosities bear witness. There is a man named Holman, who is engaged in the production of a locomotive absurdity, which is likely to be a more woful failure than the Raub or Fontaine engines. In a way, he has proceeded to out-Fontaine Fontaine. The latter amateur proposed employing two stories of wheels; Holman is going to use three ranges of them, and is having a locomotive built at the Baldwin Locomotive Works to put his ideas into tangible shape.

If the sketch of the engine which we have seen is correct, the machine under construction is an eight-wheel engine with drivers and truck resting on the wheels of other trucks. The trucks which the drivers rest upon have three pairs of wheels below resting upon the rail, and above them is another set of wheels upon which the driving wheels rest. The machine will be an ordinary eight-wheel locomotive on stilts.

The designer of this apparatus says that for one revolution of the five-foot driving-wheels the truck will carry the train as far as if the drivers were ten feet in diameter. "This invention, you will see," remarked the inventor, "doubles the capacity or power of the locomotive." He also finds it necessary to adopt improvements to keep the locomotion up with the electric motor, and his invention is going to provide what is wanted.

The trouble with this species of an inventor is that his education concerning the laws of nature has been neglected or distorted. According to the principle of virtual velocities a gain of speed brings loss of power, but the unbalanced inventor of *outré* machines and perpetual motion appliances expects to gain speed without loss of power. If the idea was correct, one might reverse a pinch bar, and by stepping on the short end move an engine with the velocity of steam—a man on stilts would run faster than a horse.

In his friction-geared truck engine, Mr. Holman proposes to add thirteen axles, twenty-six wheels and the same number of journals to an ordinary locomotive, and he imagines that this can be done without loss of power. For years the ablest engineers in this and other countries have been laboring steadily to reduce the number of moving parts in all rolling stock, and every change towards simplicity has reduced the expenses for operation and maintenance. There is little essential difference in the first-class locomotives on all the different railways in the world. Ingenious and trained engineers, with an eye for the fittest, while working thousands of miles apart, have produced practically the same locomotive. When inventors of all the absurdities which the world has seen brought forth as locomotives during the past thirty years have walked in succession into oblivion with their ridiculous productions, they have given the most conclusive testimony that the men whose business it is to design and build locomotives have not missed any important improvement.

The Richmond compound locomotive which was shown in our May number is doing remarkably good missionary work in converting railroad men concerning the economy of the compound for heavy work. After demonstrating what the engine could do on the Chesapeake & Ohio, she was sent West, and has been tested in regular train service on the Chicago, Rock Island & Pacific, the Chicago, Milwaukee & St. Paul, and at present writing is on the Chicago & Grand Trunk. From there she will be sent to the Chicago & Northwestern, and thence to the Illinois Central. The engine has been subjected to remarkably severe tests in pulling heavy trains, and in every instance has made a good record compared to the simple engines doing the same work. Although only an eight-wheel engine, this compound has pulled trains in competition with mogul and consolidation engines.

The South Baltimore Car Works are building a number of Campbell-House combination cars, to be used on the Baltimore & Ohio Railroad. This car can be converted into a stock, box or coal car with very little labor, all parts required for effecting the change being carried inside the car. There have been a few of them in use on the B. & O. for several years, and the service has demonstrated their usefulness. Railroad men familiar with traffic details say that this car is certain to increase in popularity for routes where stock cars can be used to return loaded with merchandise or coal.

The deadly trolley is not only robbing steam railroads of business which legitimately belongs to them, but it has introduced a mean element of danger which is calculated to rob the steam railroad of its safety as a traveling medium. According to the *Railroad Gazette*, a trolley car line in Massachusetts recently surreptitiously turned its current of electricity upon the rails of a steam railroad, and nearly melted a rail before the dangerous operation was discovered. By a series of accidents the current reached the rail under conditions similar to the way that an electric current is employed to do electric welding. In this case, however, the operation was reversed, and the rail was burning rapidly into oxide of iron when the thing was discovered. Something must be done to suppress the too enterprising trolley wire.

Mr. E. F. C. Davis.

Mr. E. F. C. Davis, president of the American Society of Mechanical Engineers, met a tragic death last month while riding on horseback in Central Park, New York. No person saw the accident, and he was unconscious when found, but it is supposed that the horse fell upon him, crushing out his life.

Mr. Davis was well known to railroad men, owing to his connection with the Richmond Locomotive Works as general manager, and for his successful labors on the improvement of the compound locomotive. The Richmond compound locomotive, which has been making such a fine record on various Western railroads, was designed by him, and was built under his supervision. He was an enthusiastic worker in this field, and was ambitious to secure a position where his labors to improve railroad motive power could be continued.

Mr. Davis was born at Chestertown, Md., in 1847, and came of a family of lawyers, and his parents intended him for that profession. His own preference was, however, for mechanical pursuits. When a schoolboy, he built a small working engine and other appliances which indicated the direction of his inclinations, and he strongly objected to the study of law. Very reluctantly his parents consented to permit him to go to Philadelphia to search for mechanical employment. They would give him no aid in the search. He went to a great many shops and offered himself as an apprentice, without success. One of the members of the firm of Brinton & Hendersen, hydraulic engineers, happened to visit the house where young Davis was staying, and looked at some of the mechanical toys the boy had made. This gentleman, a keen, genial Scotchman, whom Mr. Davis always talked of in the warmest terms, invited the lad to call at the works next day, and the visit resulted in his being entered as an apprentice. There he remained as machinist and draftsman for a number of years, and left to be draftsman and designer for a firm in Brooklyn, N. Y. From there he went to the Pottsville Iron and Steel Co., to become assistant to Mr. S. D. Whiting, superintendent.

In 1878 Mr. Davis entered the service of the Philadelphia & Reading Coal & Iron Co., and a year later, when he was 32 years of age, he was made superintendent. To him fell the task of organizing the shops, to put them in a condition for building and repairing mining machinery, and the work was carried out in a fashion which indicated that, as a designer of machinery and as an organizer of working operations, he had few equals.

In 1890 he left the Reading Company to become general manager of the Richmond Locomotive Works, which he thoroughly reorganized under great difficulties and put upon a modern basis as a manufacturing establishment. Some of the best work of his life was done there. He was a fertile designer of appliances for improving engines and machinery, and he had a heart's love for the business. Working at his profession was one of his greatest pleasures, but he was nevertheless a man with warm social tendencies, and loved to surround himself with friends in his pleasant home. Few men had an equal capacity for making warm personal friends. He leaves a wife and family, who mourn for one of the fondest husbands and fathers who ever graced a home. His untimely end takes from the engineering profession one of its brightest members, and deprives a host of people of a personal friend.

Council of Mechanical Engineers on Death of E. F. C. Davis.

The American Society of Mechanical Engineers desires, through its council, to spread upon the records of the society and of its council, a minute expressive of the respect and regard which its members feel and seek to make public, upon the sudden and untimely death, from an accident, of their colleague, Mr. E. F. C. Davis, president of the society.

The formal mold of memorial resolutions, in which a corporate body ordinarily records its action, seems inadequate for a proper voicing of the spirit which pervades the council in the presence of the death of one whom its members had known so well, and whom they had learned to admire and love. His wise and mature judgment, his business and professional knowledge, his conservative yet energetic counsel, and his courteous consideration for others, had made him one from whose administration of the society's affairs the highest hopes had been entertained.

Although with such grief the stranger intermeddleth not, yet the council would presume to express their heartfelt sympathy with those nearest and dearest to Mr. Davis, upon whom this blow has so crushingly fallen.

New Advertisements This Issue.

The Cincinnati Screw & Tap Company of Cincinnati, O., have a terse and "to the point" ad. on the subject of brake shoes, to which attention is directed.

Earle C. Bacon, engineer, and New York representative of the Pacific Iron Works, Farrel Foundry & Machine Co., etc., has an advertisement of the Bacon hoisting engines, Farrel's rock and ore crushers, railroad cranes, etc., on page 603.

H. K. Porter & Co., Pittsburgh, Pa., have an attractive card, showing ten different types of their light locomotives, which they build for all gages of track and for every variety of service, from 3 to 45 tons weight—to be operated by steam, compressed air or electricity. Their sixth edition catalogue (just out) will be sent free to any one having the care or management of locomotives.

The Chicago Electro-Mechanical Enterprise Co. is the title of one of our new advertisers this month, who have an office in the Monadnock Block, Suite 1339 and 1340. They offer to invent to order—make drawings—design machinery or devices in mechanics, chemistry or electricity, solicit patents, and interest capital. J. Francis Small is president of the company and chief of mechanical department.

The Davis Sewing Machine Co., Dayton, O., have a quarter page advertisement of their bicycles.

The Champion Automatic Car Coupler Company, of Kenton, O., have an announcement to make.

Hendrick Mfg. Co., Carbondale, Pa., have a special ad. of their locomotive spark arresters in this issue.

Bryan & McKibbin, of 120 Broadway, New York, who have just formed a copartnership, have their card in this issue.

The Lima Locomotive & Machine Company, Lima, O., manufacturers of the Shay patent locomotive, have an advertisement in this issue.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(115) R. Y. B., Kalamazoo, Mich., asks:

What is the easiest rule for converting figures that are given of kilometers into miles? *A.*—Multiply by .621.

(116) A. J. K., Somerville, Mass., writes:

If the driving wheel of a four-wheel switching engine breaks, can it be fixed to run to repair shop? *A.*—Not very well. It would depend upon the extent of the breakage.

(117) Trainman, New Haven, Conn., asks:

What is the most economical load for a locomotive? *A.*—As a rule, the last car she can haul over the heaviest grade on the division.

(118) J. P., Dallas, Tex., writes:

If a boiler be tested and pop set at 130 pounds, and the safety valve should stick and the steam rise to 180 pounds, would it be safe to put water in the boiler? *A.*—Certainly. It would be the easiest way of reducing the pressure.

(119) E. E. E., Fort Madison, Ia., writes:

1. Is it possible to give the valve motion of a locomotive constant lead with a shifting link? *A.*—Yes, in one direction. 2. If so, describe how it can be done. *A.*—It is done by giving the back-up eccentric about 10 degrees more angular advance than the forward eccentric.

(120) B. M., Terre Haute, Ind., writes:

I met with the term "manometer" in a scientific paper, and cannot find out what it means. The word is not in Webster's Dictionary. Several of your readers would like to see the definition of the word. *A.*—A manometer is an apparatus consisting of short columns, filled with mercury, and employed for measuring light pressures.

(121) R. C. Z., Valley Junction, Ia., writes:

I find that facing safety valve until the flange stands away about the thickness of a piece of paper from the seat gives a less reduction of steam in blowing off, while at the same time it increases the area, which ought to make the reduction more. Why is this? *A.*—You make a sort of pop valve.

(122) Subscriber, Chillicothe, Mo., writes:

Please describe the water brake. *A.*—A small jet of water is injected in the exhaust pipe, which supplies to the cylinders steam at a low tension, and prevents heating, instead of the hot air and gas that would be drawn in from the smokebox; the engine is run reversed, the amount of braking power depending upon the position of the lever.

(123) R. A. Y., Cleveland, writes:

What do you consider the best way to support a brick arch? Some use angle irons riveted to the side sheets, others use pipes. Do you consider pipes safe? *A.*—We think that water tubes make a better support to a brick arch than angle irons, which soon burn off. The tubes are perfectly safe if they are properly made. Inferior tubes often sold for this purpose are dangerous.

(124) J. S., Quincy, Ill., writes:

1. I see in answer to traveling engineer's questions that we are directed to block both links in case of a reach rod breaking. Why should this be done? *A.*—Because it is safe practice. 2. The time-honored question is discussed whether or not the crosshead moves backward when starting from the forward center. *A.*—The answer to this is that it moves backward in its relation to the guides, but in its relation to the earth it moves in the direction the engine is going.

(125) R. M. S., Dubuque, Ia., writes:

We have a dispute about what locomotive builder was the first to build locomotives with the mud ring of the firebox set above the frames. I contend Schenectady Locomotive Works were the first to do this, others say they were not. What do you think? *A.*—The first locomotive designer to place the firebox above the frames was James Milholland, master of machinery, of the Philadelphia & Reading. This was done with the engine "Vera Cruz," built in 1859. The plan has been used more or less ever since.

(126) J. L. S., East Grand Forks, Minn., writes:

1. Are the center of the driving wheel and center of cylinder always in line? *A.*—No. 2. If not, how is the excess of angularity of the main rod provided for, so that steam will be distributed evenly? *A.*—This is provided for in the scheming of the valve motion. 3. Is the suspension stud placed further from the center of the saddle on engines with short main rods, other parts being in proportion? *A.*—Not necessarily. But it is the easiest way to equalize the cut-off.

(127) J. E. G., Delano, Pa., writes:

In case you have an engine that the bottom rocker arm center is one inch or more above the axle center, is it proper to take your length of valve rod from center of valve seat and center of rocker shaft, or is it more correct to take it from valve seat center and top rocker arm center, making rocker square with eccentrics center line? The rocker arms are both one length, 11 inches, and cylinder center is 5 inches above axle center; length from rocker to axle, 73 inches; valve, $5\frac{1}{4}$ travel. *A.*—Measure from center of valve seat to center of upper rocker arm.

(128) Worker, Syracuse, N. Y., writes:

I have been reading up about steam and find that it has a tremendous velocity at high pressure, but I cannot find any intelligible rule for finding that velocity. Is there any rule to calculate it? *A.*—The rule of text books is that the velocity of escaping steam is as the velocity of a body falling from a height equal to the column of steam represented by the steam pressure. The best-known rule for calculating the velocity is: To the temperature of the steam add the constant 459, and multiply the square root of the sum by 60.2, and the quotient will be the velocity of the steam per second, if the outside pressure is not more than 58 per cent. of the inside pressure. Thus, take a boiler pressure of 100 pounds per square inch passing into a cylinder with less than 40 pounds pressure in it. Temperature of steam $337.5 + 459 = 796.5$ $\sqrt{\ }$ $28.2 \times 60.2 = 1{,}697$ feet per second.

Mr. Louis Meyers, an engineer on the New York division of the Pennsylvania Railroad, who is running a high-speed engine, is a great believer in Dixon's graphite in helping to prevent hot pins and bearings. He says: "By using Dixon's graphite I can couple on my train and run ninety miles with safety. I have used it on different classes of locomotives, and always found it satisfactory when anything runs hot on the road."

Men were not very much less intelligent during the first half century of railroading than they are to-day, yet in those days curious superstitions arose and flourished concerning locomotives. Engines were regarded with awe and mystery. The machines made of brass and iron were supposed to have characteristics that the ordinary man could not comprehend. It was supposed that years of familiarity were necessary to enable an engineer to understand the idiosyncrasies of a locomotive. A wife of uncertain temper was no circumstance compared with a well-built locomotive. It was the custom to marry one man to an engine for life, and if anything happened to prevent them from going out together, no other human substitute might attempt the task. The engine needed constant petting and humoring, and none but the regular man could induce her to pull a decent train or go over the road on time. To the old-time engineer, the teaching that one man could do as well with an engine as any other man was a sure indication that railroad life was going to the dogs. It was on a par with the belief that one engine of the same size as another was capable of doing as much work. There was great breaking of idols when the superstition concerning the exceptional power and speed of certain engines came to be doubted. The romance of railroading departed when figures became more potent than beliefs.

AN experienced, able and energetic man desires an engagement in railway or machinery supplies, as manager or salesman. Best references. Address "B," care LOCOMOTIVE ENGINEERING, New York.

WANTED—Position as salesman of R.R appliances or supplies, by a gentleman with a long experience, large acquaintance and recognized ability; references exceptionally good, salary moderate; address "A," care LOCOMOTIVE ENGINEERING, 256 B'dway, N. Y.

WANTED—With a reliable and progressive house catering to the R.R. trade, a position by a steady and sober young man who has traveled and sold goods to other trade, and also has a general and practical knowledge of mechanics and possesses executive ability to handle men and work to best advantage. Best of references. Address "H," care LOCOMOTIVE ENGINEERING, 256 Broadway, New York.

Don't put off another day, but send your name and address for a New Price List of high-grade American Watches, **now**, to

S. N. CLARKSON & CO.,

Champlain Building, Chicago, Ill.

We are Special Agents for the following well-known watches: The "President," "Vanguard," "Time King," "Special Railway" and "Rockford."

We are the leading R. R. jewelers in Chicago, and will send goods C. O. D. on approval to any address in the U. S. Our motto is High-grade Goods for the least money.

Write for Catalog. Established 1884.

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For Sale

The following Machinery, slightly Second-hand.

Especially Adapted for Car Shops.

2 Bement Car Axle Lathes.
2 32-inch Bement Car Wheel Borers.
1 42-inch Bement Car Wheel Borer.
1 20-inch x 11 1-2 feet Wm. Sellers Engine Lathe.
1 32-inch x 8 feet D. W. Pond Engine Lathe.
1 51-in. - 60-in. x 26 ft. New Haven Triple-Geared Lathe.
1 19 inch x 8 feet Pratt & Whitney Lathe with Taper.
1 21-inch x 9 feet Pratt & Whitney Lathe.
1 25-inch Prentice Bros.' Drill with B. G. & P. F.
1 30-inch " " " " " "
1 28-inch Barnes Drill, B. G. & P. F.
1 43-inch Vertical Boring Mill.
1 3-inch bar, 60-inch swing, Betts' Horizontal Boring Machine.
1 32-inch x 32-inch x 10 feet Pond Planer, 2 heads.
1 36-inch x 36-inch x 10 feet " "
1 14-inch Lowell Traverse Shaper.
1 2 1-2-Inch Hurlbut Cutting-off Machine.
1 60-tons Watson & Stillman Broaching Press.
1 12-inch Bement Slotter, all feeds.
1 No. 3 Brown & Sharpe Universal Milling Machine complete.

600 Machine Tools in Stock. Send for Lists.

PRENTISS TOOL & SUPPLY CO.,
115 LIBERTY ST., NEW YORK.

Chicago Store, 62 & 64 So. Canal St.

Selling Agents for
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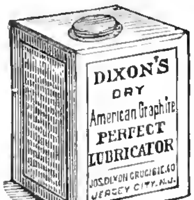
Cincinnati Milling Machine Co.
Bickford Drill & Tool Co. Putnam Machine Co.



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An engineer, whose engine has run 115,000 miles with slight running repairs, is noted as a "puller" on heavy grades, economical in fuel and oil, and often commented upon by officers, train dispatchers and trainmen, and believed to be a superior built engine, says, "The secret of success is the daily use of Dixon's Graphite, which gives a bright polish to valves, pistons and cylinders."

Let us send you sample and pamphlet.

Jos. Dixon Crucible Co.,
JERSEY CITY, N. J.

Machine Tools

57-inch Double Head Driving Wheel Lathe.
16-inch F. B. Miles Slotting Machine.
2400-Pound Miles Steam Hammer, Single Stand'd.
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Horizontal or Floor Boring Machine, Pratt & Whitney.
Two (2) 5-ft. Universal Radial Drills.
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19 in. x 8 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
26 in. x 8 ft. Pond Machine Tool Co. Engine Lathe.
19 in. x 12 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
22 in. x 12 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
40-inch Bement Vertical Drilling Machine.
24-inch Pratt & Whitney Vertical Drill'g Machine.

George Place Machine Co.,
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STEEL RULES.

Ends Hardened.

Graduated in 8ths, 16ths, 32ds and 64ths.

12 inch, - $1.00 6 inch, - $0.50
4 " - - .30 3 " - - .25

On receipt of price any time previous to Oct. 1st, 1895, we will mail to any address in the U.S. one or all of the above rules; we warrant them accurate. Catalogue free.

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ATHOL, MASS., U. S. A.,
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Mechanics' Fine Tools
ATHOL MACHINE CO.
SELLING AGENTS.

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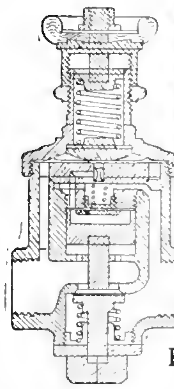

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STEAM OR AIR
NEWARK REGULATOR CO.
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FOR CAR HEATERS
HAS NO EQUAL.

Sent on approval to responsible parties.

YANKEE TWIST DRILL GRINDER

This machine grinds all sized drills, from 1/8 to 2 1/4 inches. Set for any size in two seconds. Gives the proper clearance and can't grind a drill wrong. Address,

G. T. EAMES CO.,
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"THE CHAMPION."

A Strictly Automatic Coupler and Un-Coupler.
Self-opening Knuckle. No Springs.

By its use it is impossible for cars to be wrecked by bars pulling out or breaking and falling on track. Will couple on any curve. Can use link and pin with or without knuckle.

FOR ENGINES, PASSENGER AND FREIGHT CARS.

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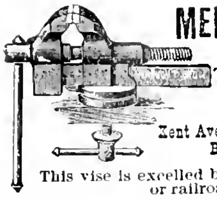

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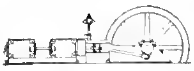
Turnbuckles and Parallel Vises,

Kent Ave. and South 11th St., Brooklyn, N. Y.

This vise is excelled by none for heavy machine or railroad shop work.

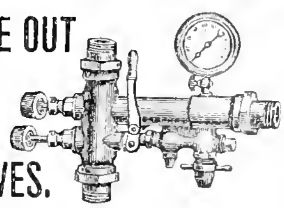
E. SPANGENBERG'S

Manual of Steam Engineering,



Containing more than 2,000 Questions with Argued Answers, and over 500 illustrations; also his Arithmetic, Algebra, Plane and Solid Geometry, are sold by every reliable book dealer for **75c.** per volume. Will be sent post-paid after receipt of price by THE LABORER'S INSTRUCTION PUB. CO., 314 N. 3d St., St. Louis, Mo.

PUMPS ARE OUT OF DATE ON LOCOMOTIVES.



Because injectors are better in every way. Pumps are also out of date for boiler washing purposes. Here is a jet instrument that occupies no room, needs no foundation, and takes cold water, delivering it hot. The best washer for the boiler. With the testing attachment you can put 300 pounds of hot water pressure on a boiler using 100 pounds of steam. The whole thing in compact shape, showing just what pressure you are using. You can buy ten for the price of one pump of the same capacity.

ALSO, LITTLE GIANT INJECTORS.

Rue Mfg. Co., 119 N. 9th, Philadelphia, Pa.

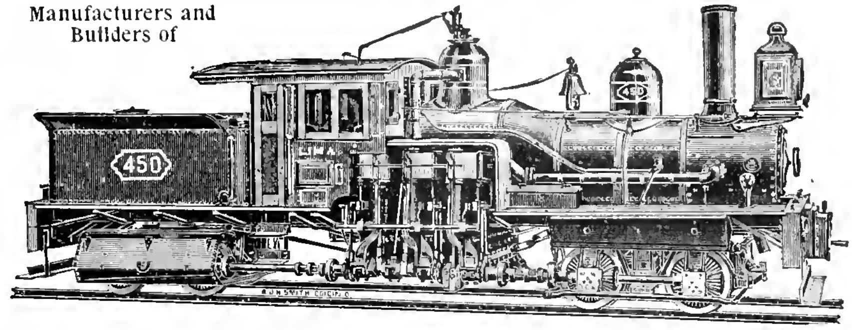
THE screw being lubricated and protected, the Jack is always ready for instant service. Railroad men appreciate the importance of having Jacks always in good working condition. Serious delays frequently occur in getting common Jacks so that they can be worked when suddenly required in train service.

Common Jacks are frequently destroyed in efforts to make them work quickly after the screws are set with rust and dirt. This consideration alone makes the **CHAPMAN JACK** the most economical one to purchase.

THE CHAPMAN JACK CO., CLEVELAND, OHIO.

THE LIMA LOCOMOTIVE AND MACHINE COMPANY, LIMA, OHIO.

Manufacturers and Builders of



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AN UNSOLICITED TESTIMONIAL

(a sample of many), from an Educational Association of Engine and Train men:

"We have your book, DISEASES OF THE AIR BRAKE SYSTEM, and consider it the *very best book* in our possession."

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Used and endorsed by J. A. FAY & EGAN CO., MORSE TWIST DRILL AND MACHINE CO., WILEY & RUSSELL MFG. CO., FITCHBURG MACHINE WORKS, and by all who have given it a trial.

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Correspondence solicited and held strictly confidential.

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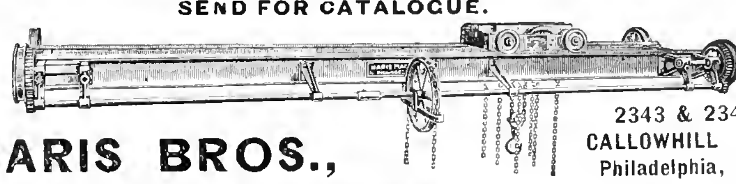


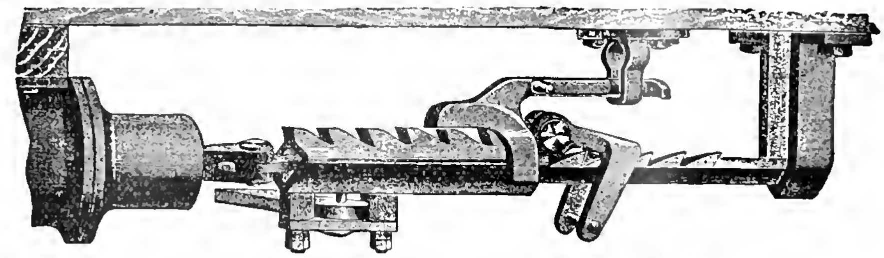
MARIS BROS.,

2343 & 2345 CALLOWHILL ST., Philadelphia, Pa.

Classified Index of Our Advertisers.

Continued on page 595.

THE **O. K. BRAKE ADJUSTER.**
Insures the Maximum pressure on the Brake Shoes at all times.



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ON THE
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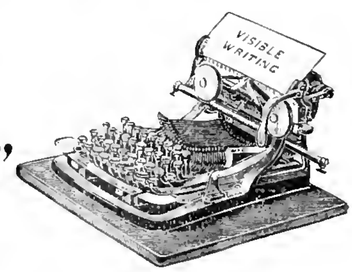

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"NATHAN" SIGHT-FEED LUBRICATORS.
For Locomotive Cylinders and Air Brakes.
STEAM FIRE EXTINGUISHERS.
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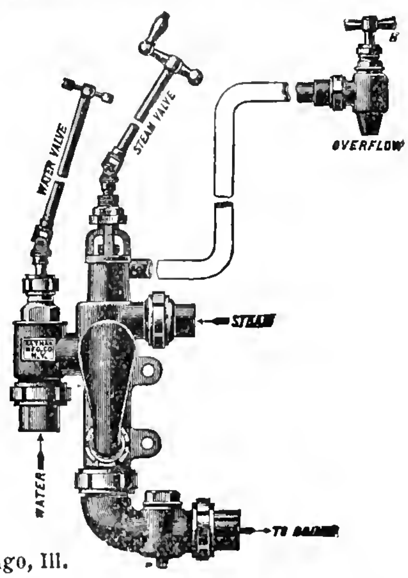

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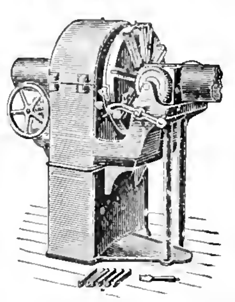

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OUR ADJUSTABLE STOCKS AND DIES ARE THE MOST CONVENIENT, DURABLE AND SATISFACTORY TOOLS OF THE KIND IN THE WORLD.

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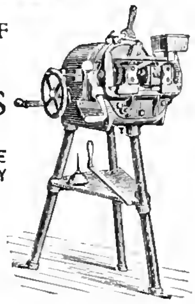

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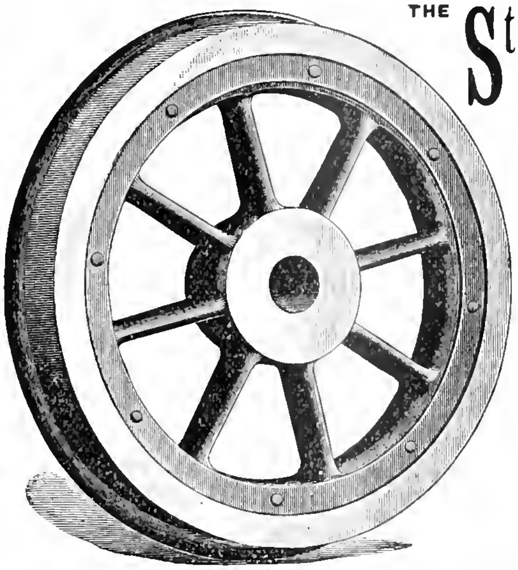
WROUGHT IRON WHEEL CENTRES. VAUCLAIN'S PATENT.



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ROOD & BROWN, CAR WHEEL WORKS,

BUFFALO, N. Y.

RAILROAD, CAR, ENGINE, TENDER AND TRUCK WHEELS

Made from the Best Charcoal Iron.

Office and Works: HOWARD and THOMAS Streets

TANGYE'S HYDRAULIC LIFTING JACK.

A GOOD, RELIABLE JACK for Lifting or Pushing in any direction. The lever is for pumping it up, the key lowers and stops it at any point, when it is again ready for lifting, saving time and trouble.

Various sizes made, from 4 tons to 200 tons.

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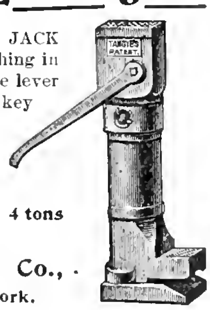

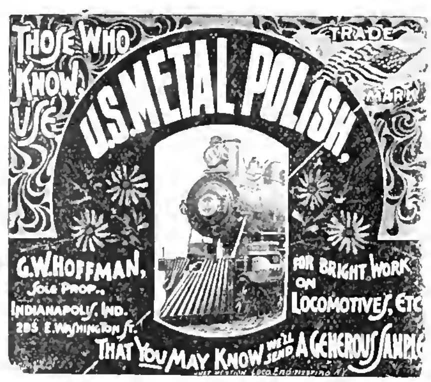

Continued on page 590.

CLASSIFIED INDEX OF ADVERTISERS—*Continued.*

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Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
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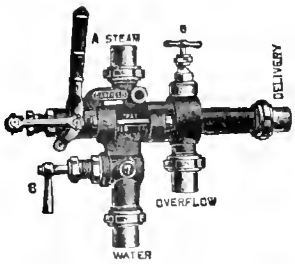

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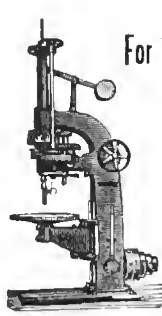

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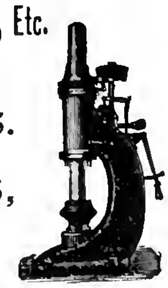

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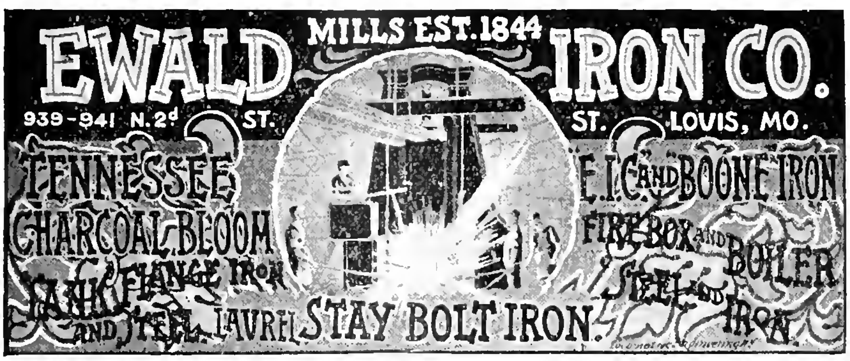

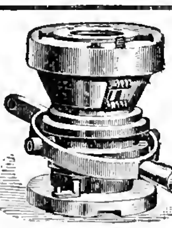

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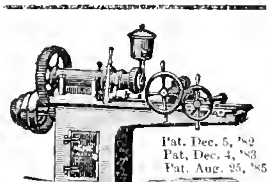

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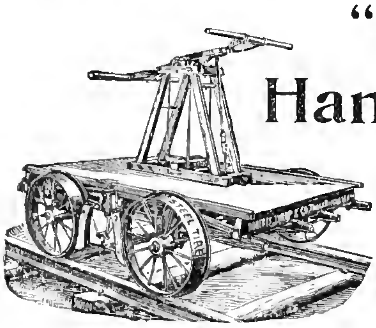

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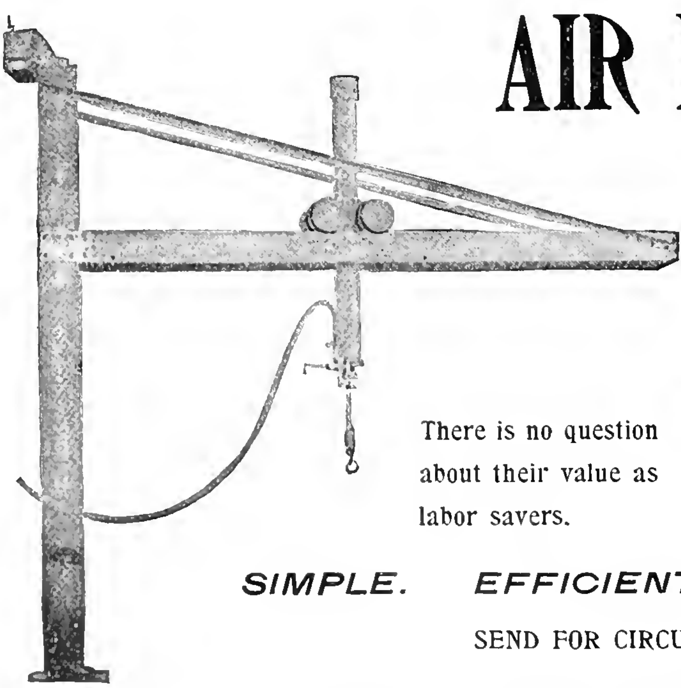

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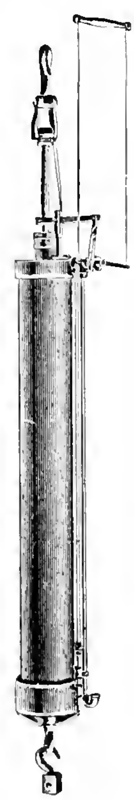

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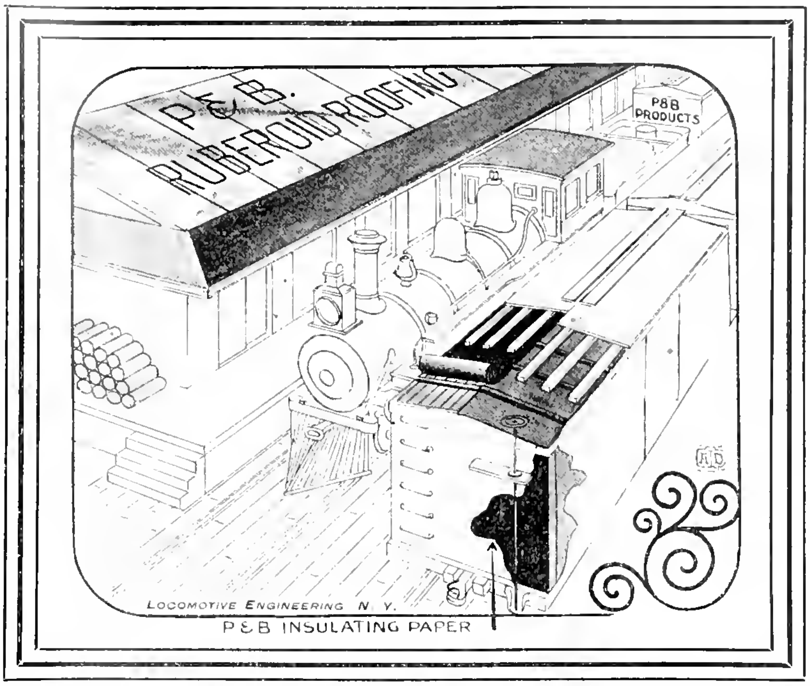

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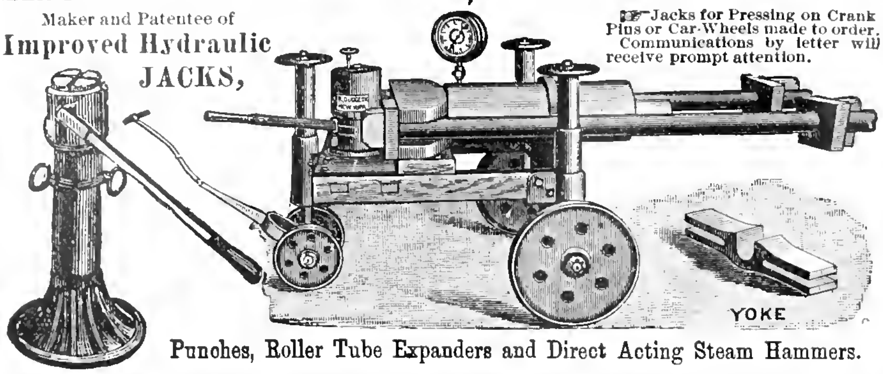

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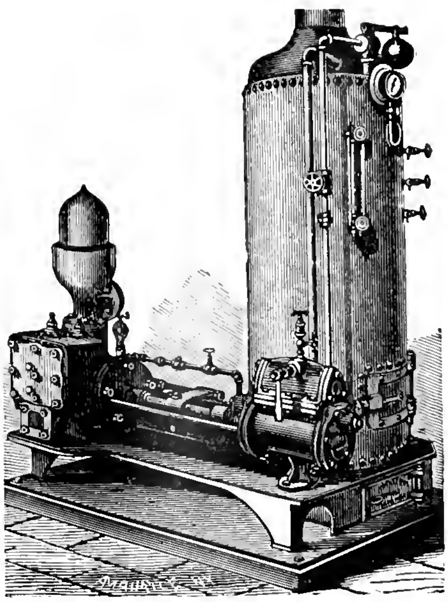

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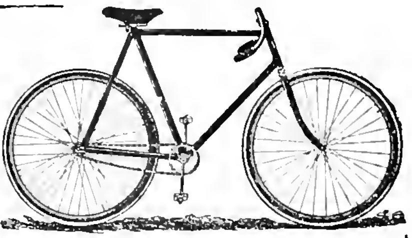

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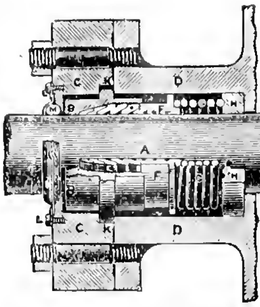

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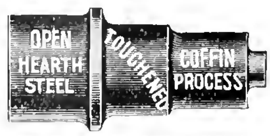

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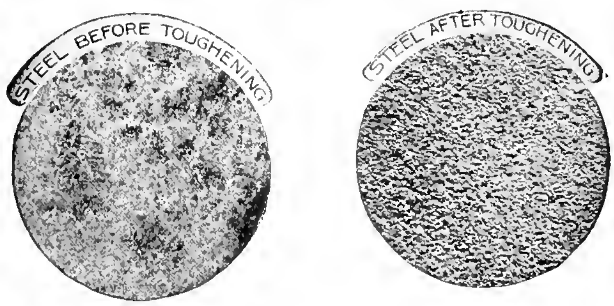

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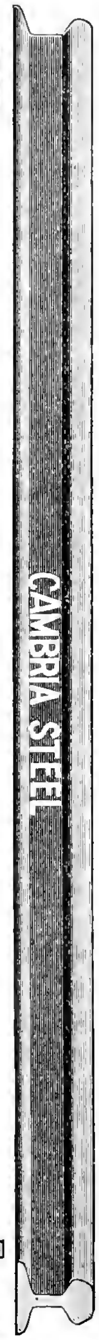

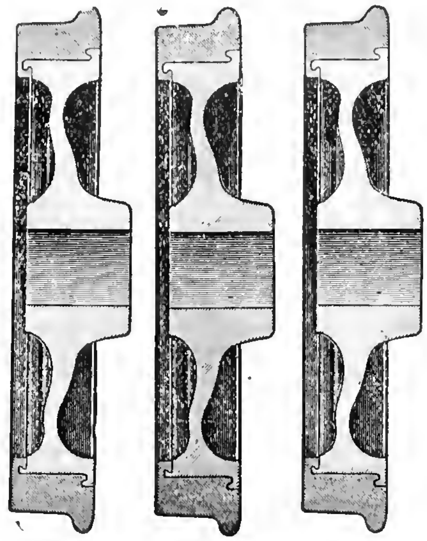

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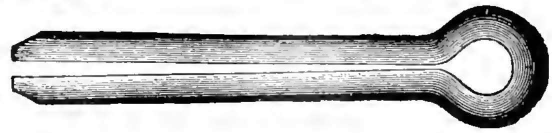

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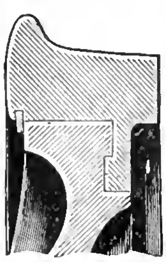

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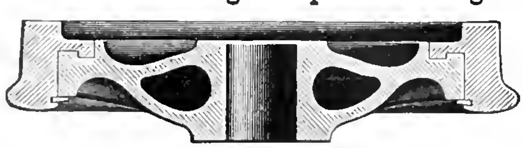

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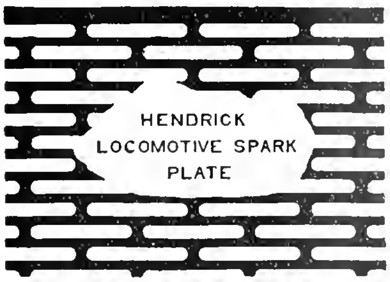

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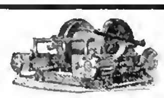

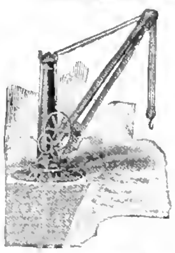

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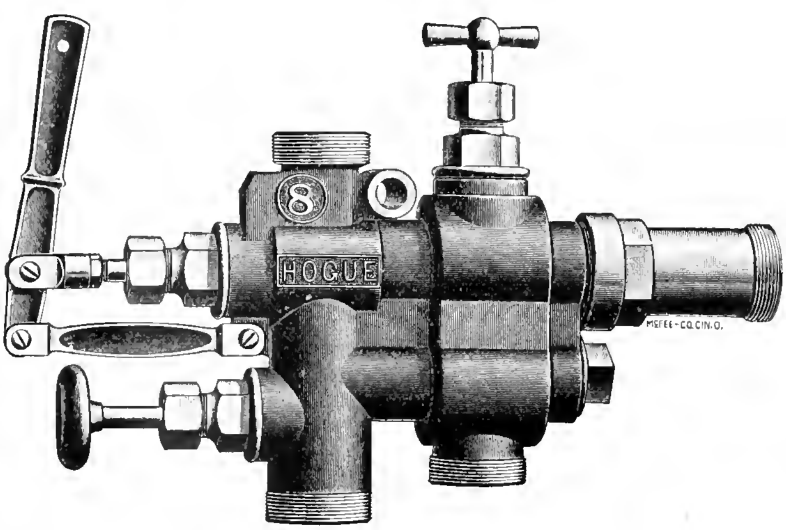

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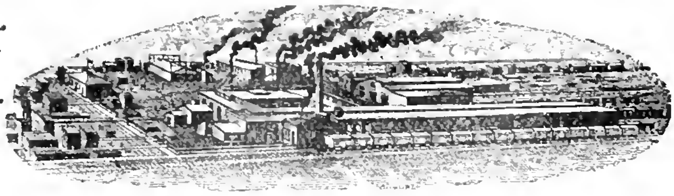

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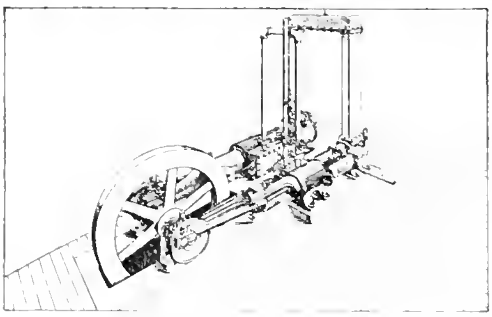

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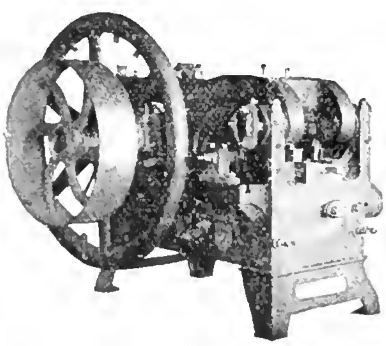

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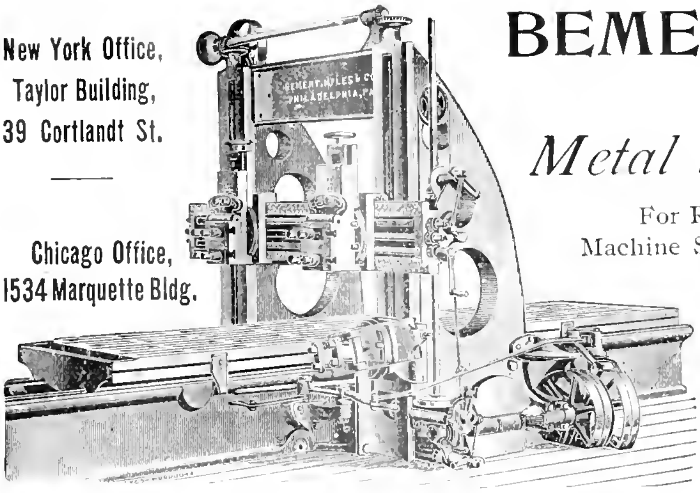

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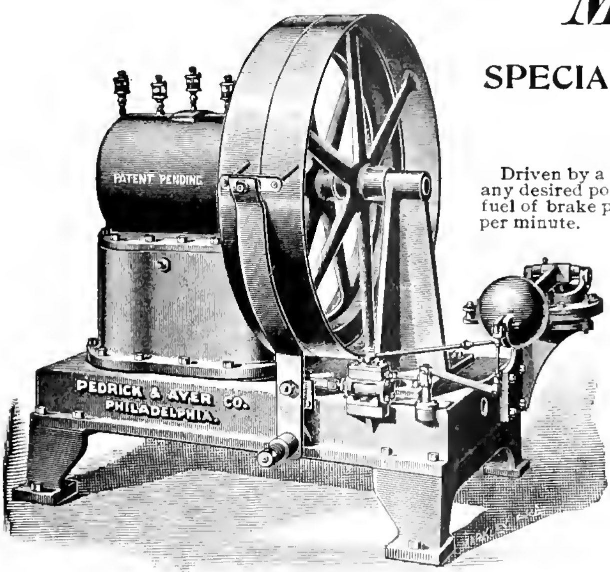

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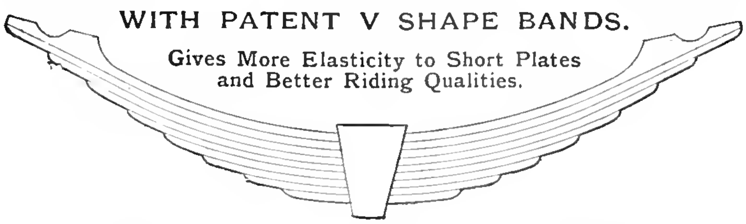

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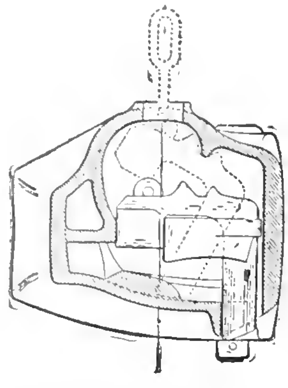

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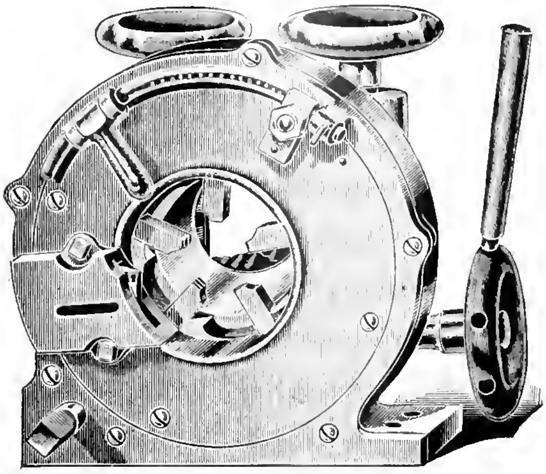

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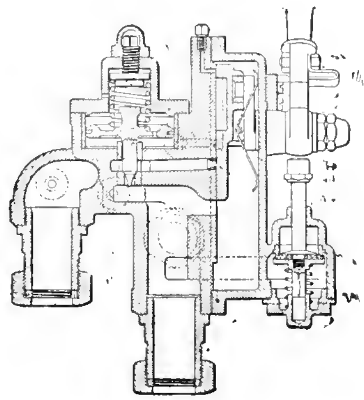

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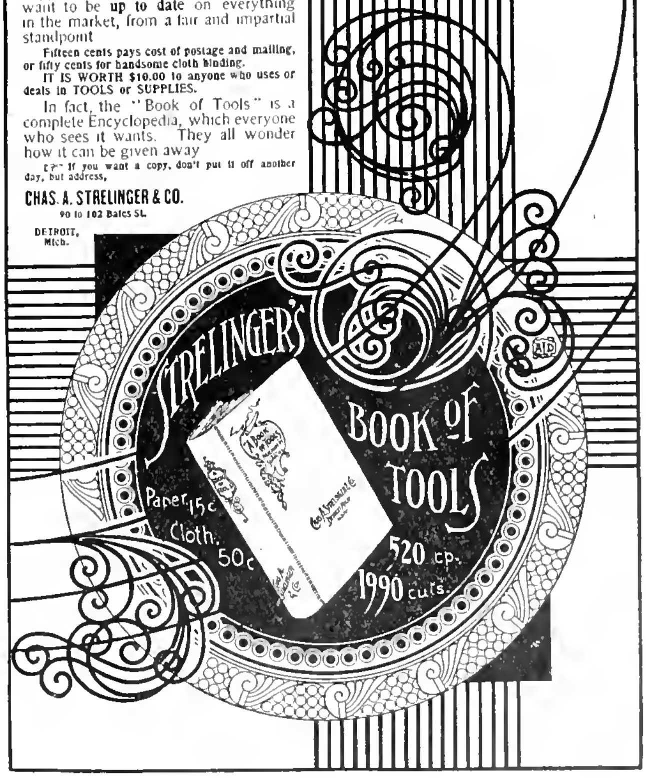

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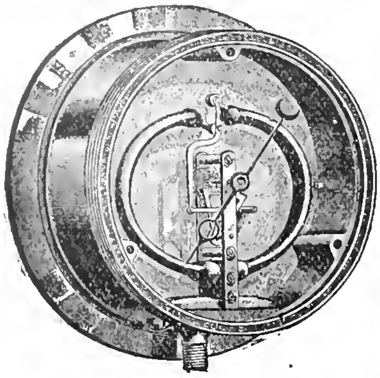

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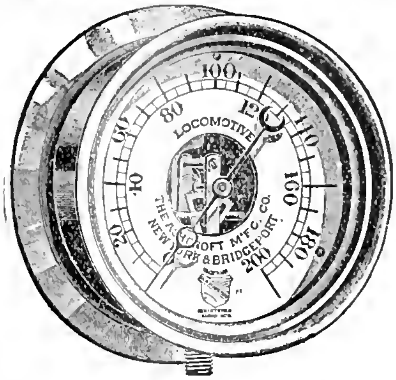

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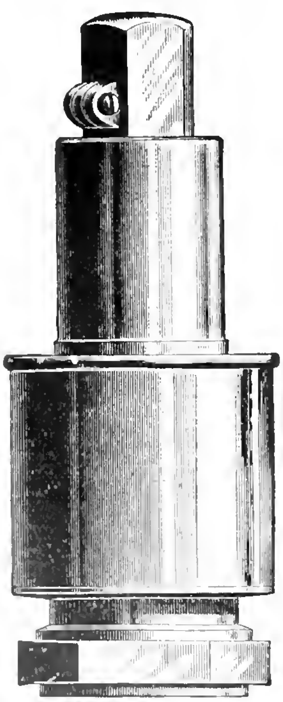

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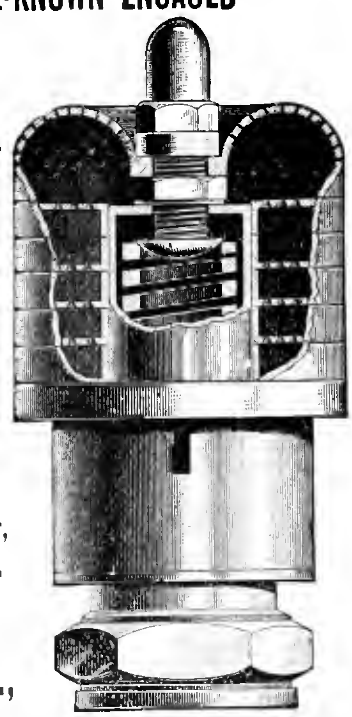

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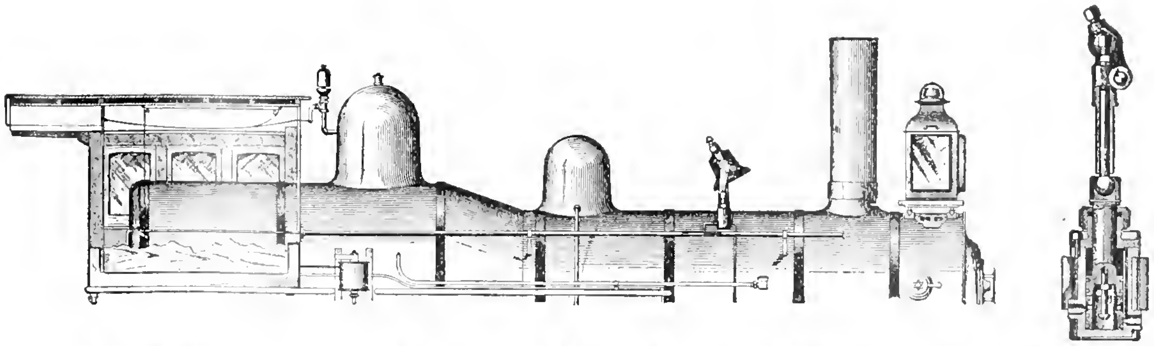

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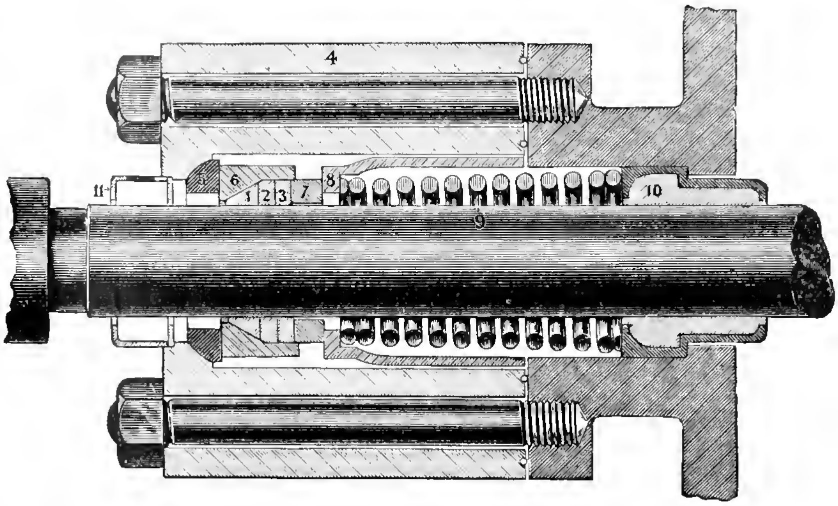

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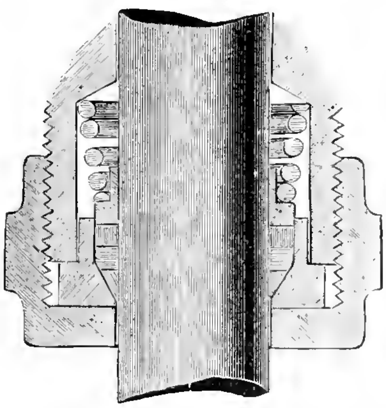

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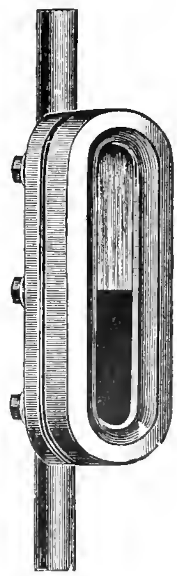

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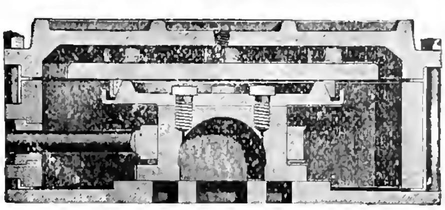

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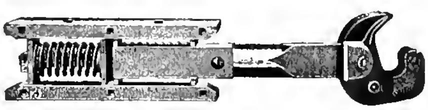

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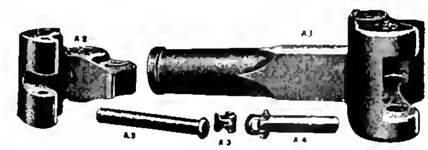

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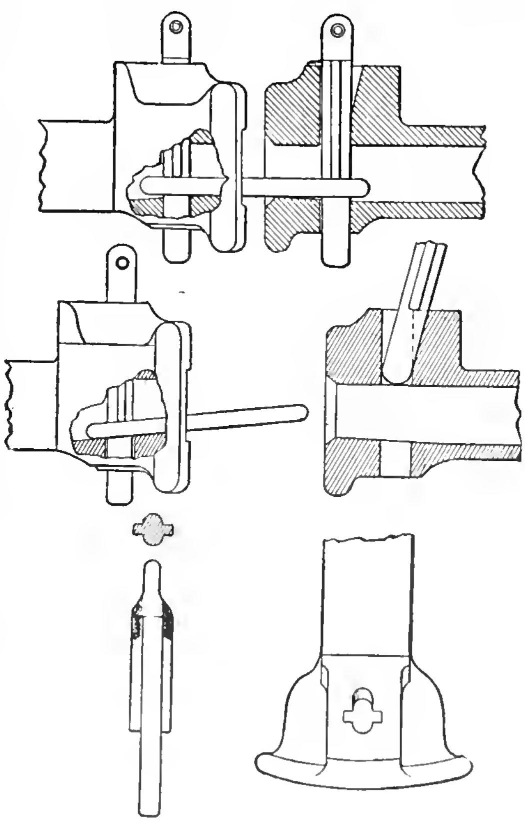

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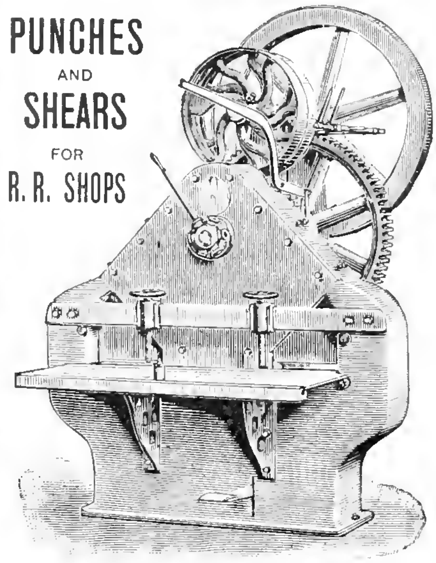

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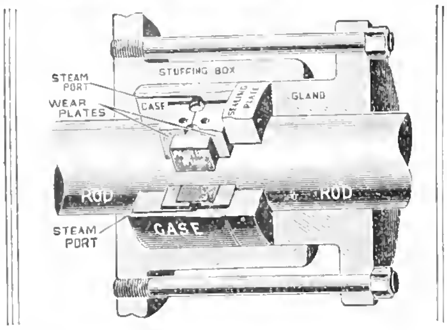

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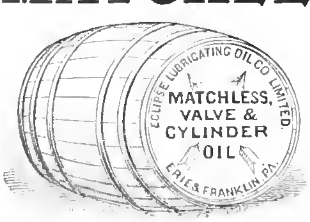

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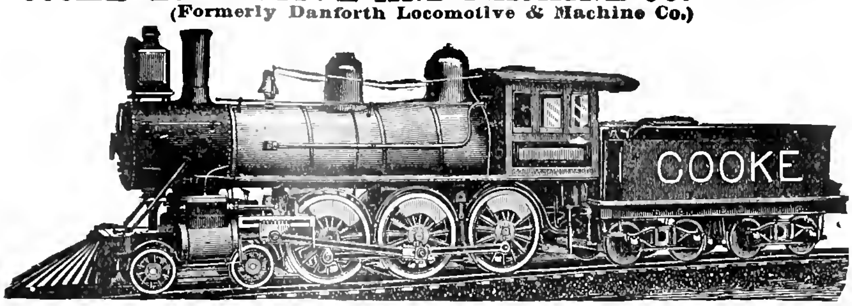

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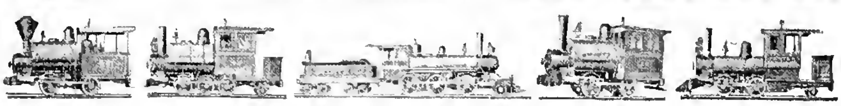

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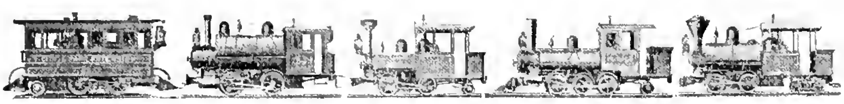

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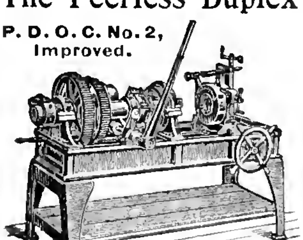

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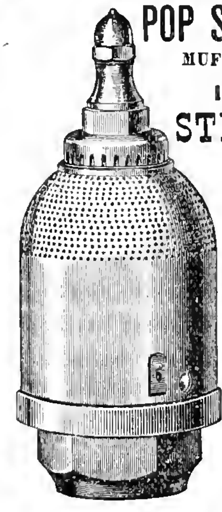

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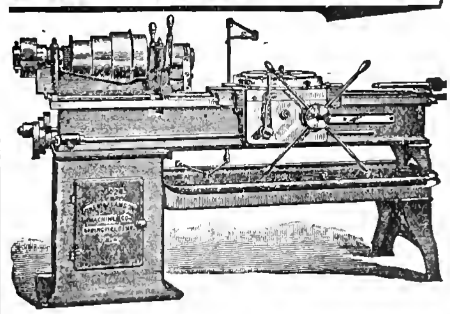

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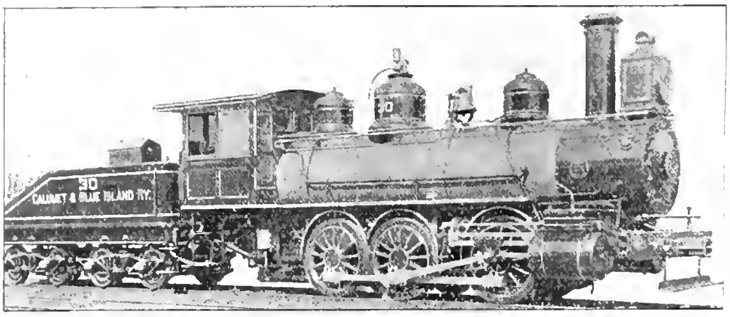

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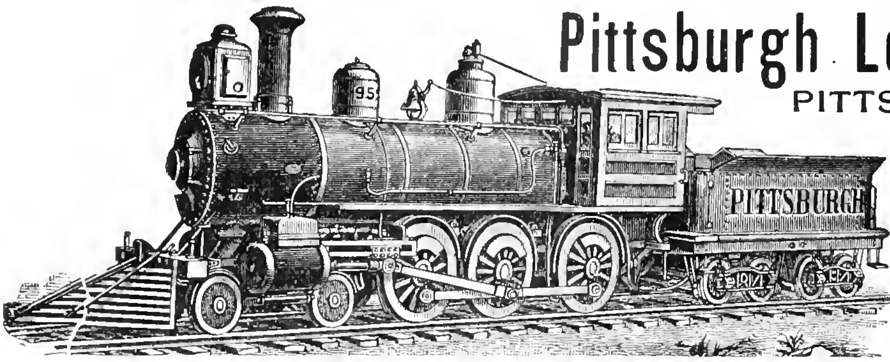

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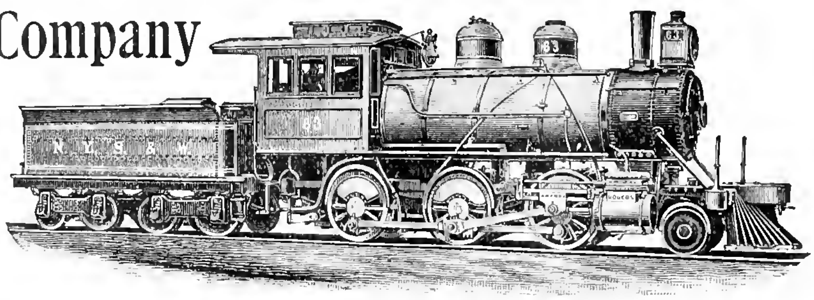

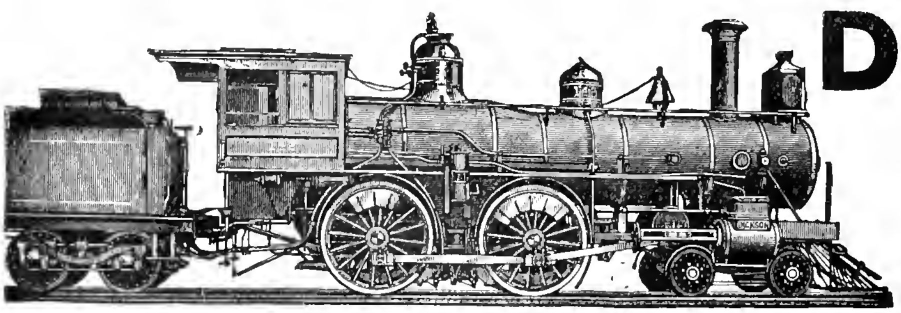

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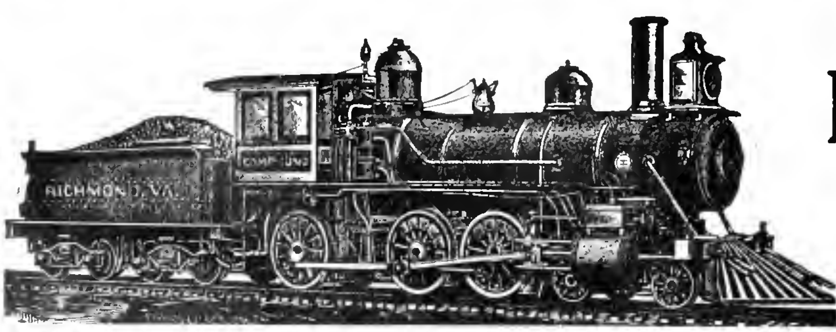

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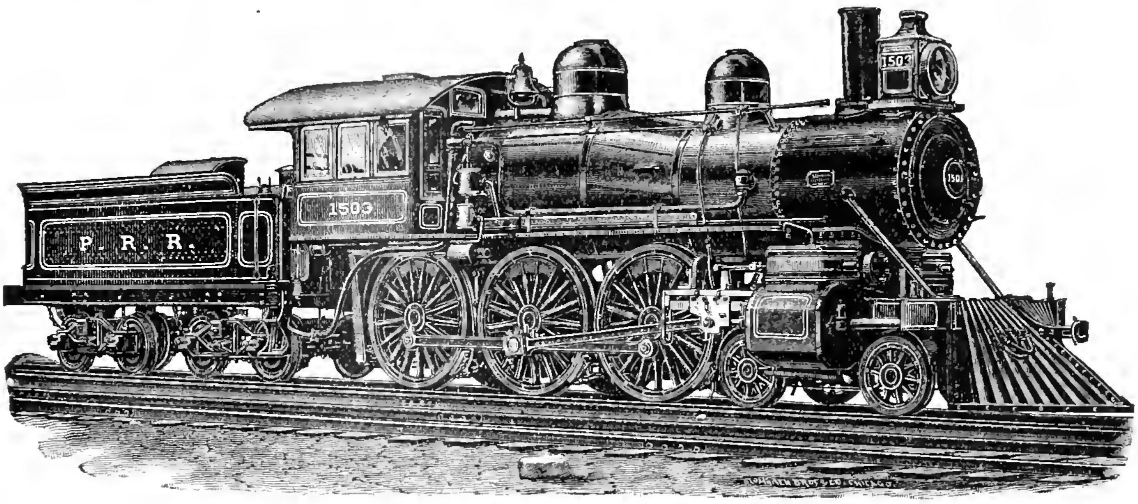

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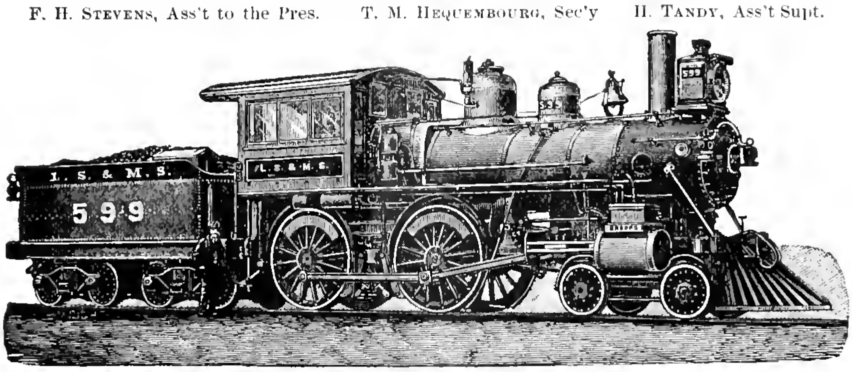

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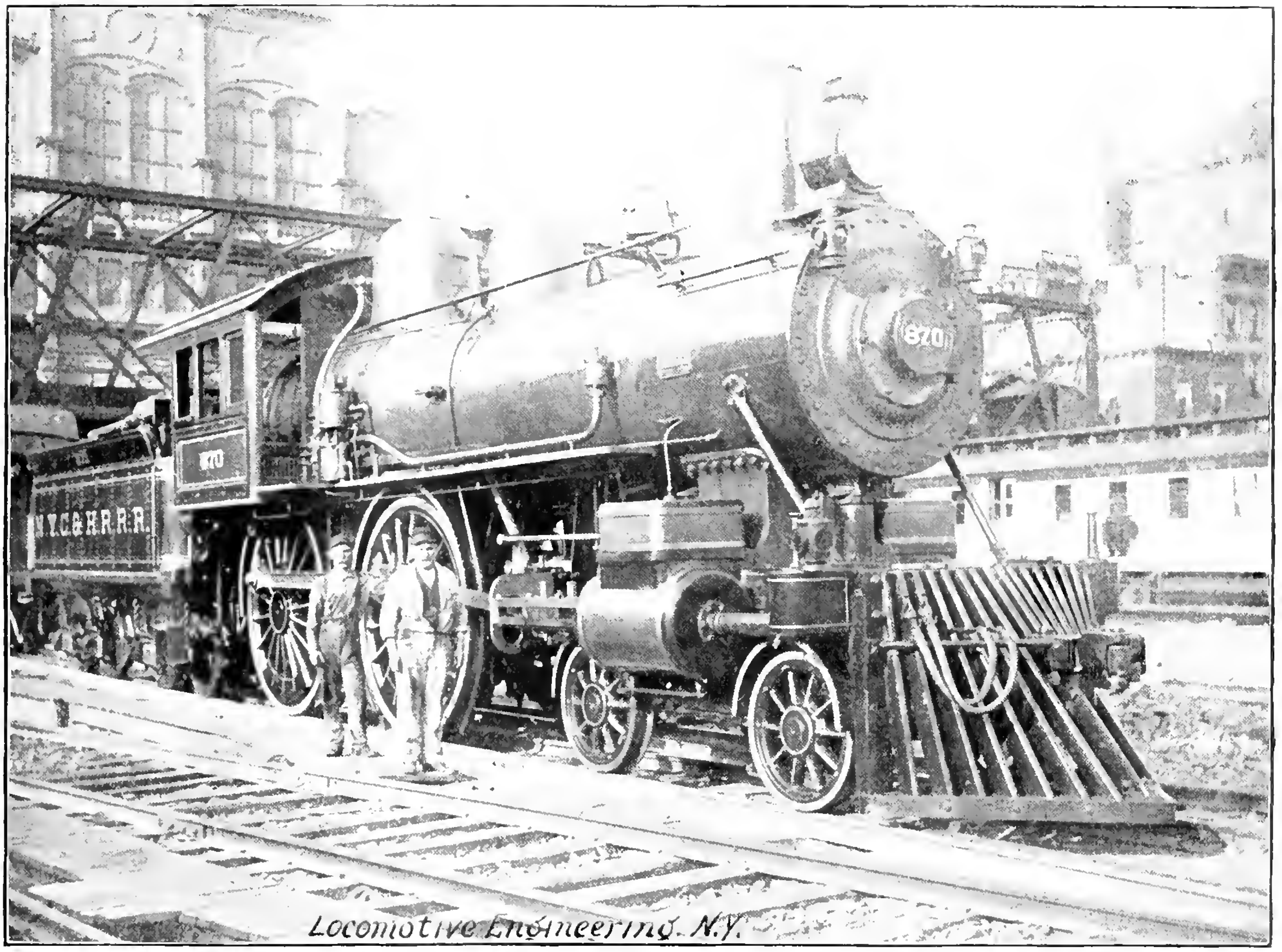
[Trade Mark Registered.]
Vol. VIII. 256 BROADWAY, NEW YORK. No. 10

Breaking the Train-Speed Record.

In our September number we gave particulars of the wonderful speed made by trains on the rival coast routes between London and the north of Scotland. The finishing run made by the West Coast route, consisting of the London & North-



RECORD ENGINE, HUDSON RIVER DIVISION, WITH ARCHIE BUCHANAN AND FIREMAN ELLIOTT READY TO LEAVE GRAND CENTRAL STATION, NEW YORK.

western and the Caledonian railways, of 540 miles in 513 minutes, a speed between terminals a little over 63 miles an hour, broke the record for the speed of railroad trains, and left the New York Central's great speed achievements away behind. The New York Central people are not the kind of individuals who enjoy having their laurels carried away. When the question of reputation for getting their trains there as fast as the next road comes in question, they rise into a fighting mood.

Their friends fan the flame of rivalry. Since the British beat the record, every official of the New York Central, from the chairman of the board to the trainmaster, has been receiving letters inquiring if they intended to stand that. The passions aroused by the curious ending of the yacht race, moved our pugnacious citizens to egg on the New York Central to beat the West Coast record. Pressure of that kind is hard to resist, especially when all concerned are hankering to prove that a first-class American railroad can do a little better in the way of speed than anything else that uses wheels.

As the London correspondents and the Anglo-sympathizing writers for the daily papers kept impressing upon their readers how slow our best speed performances were compared to the English-Scottish 63 miles an hour train, I began to feel that there would be cause for a reaction di-

rectly. Without the least hint from anyone, I made up my mind that the New York Central would do something pretty soon, and I was just thinking that I would go up to the Grand Central Station and try to pump my friend, Superintendent of Motive Power Buchanan—the most non-committal man that ever crossed the Scottish border—when a telephone message from Mr. A. G. Leonard, private secretary to Vice-President Webb, called me to the latter gentleman's office on "confidential" business. Intimation was given that another fast run would be made to Buffalo soon.

A few mornings afterwards, about a dozen people were breakfasting at 5 o'clock in the morning in Mr. Webb's private car, which stood at the hind end of a train with three day cars and our old friend the "870" in front, with Mr. Archibald Buchanan, the veteran engineer, looking round, giving final oil touches, and appearing as if one of the joyful events of his life was about to come forth.

Very careful arrangements had been completed in advance for keeping an exact record of the time made from start to finish. Three sets of time cards were prepared, on which three men were to enter the time of passing each station. One was Professor P. H. Dudley, one of the most accomplished engineering physicists living; another was Mr. A. G. Leonard, assistant to Mr. Webb; the other was the writer. We carefully compared our watches before starting, and adjusted the second hands to the same position. At 5:40:30 the engine started the train, and in a few seconds we were rushing through the tunnel at a speed which indicated that Archie intended doing his best to beat the record to Albany. From previous experience we knew that the speed must cover each mile, where checking up is not necessary, in about 50 seconds, if we were going to surpass the West Coast run. The first 12 miles out of New York are discouraging to those who look for an excellent start. Until the rock cuttings and sharp curves of Spuyten Dayvil were passed our progress was a series of spurts into speed and checking up for curves or something that called for cautious running. An impression made early in the journey was that the engineer was not taking any chances. The fast run over the division would not be accomplished at the expense of safety.

As we entered upon the straight reaches of the road, the speed was quickly pushed up to a mile in 50 seconds—that is 72 miles an hour. A great part of the entire run was made at that velocity. It seemed a comparatively easy matter for the engines to lift the train into a speed of 60 miles an hour, but getting up to 12 or 15 miles more was intensely difficult. If the track was fairly straight for a long stretch, and there were no causes for slowing down, the speed would laboriously rise to a mile in 48 seconds, which is 75 miles an hour. When occasion arose to slow down to a mile in 70 seconds, which is 51.4 miles an hour, we would not gain more than two seconds per mile till we reached 60 miles an hour, and after that the working into the higher speed was done at about one second gain per mile. The train was so heavy that the engine could hold up the high speed only under the most favorable conditions.

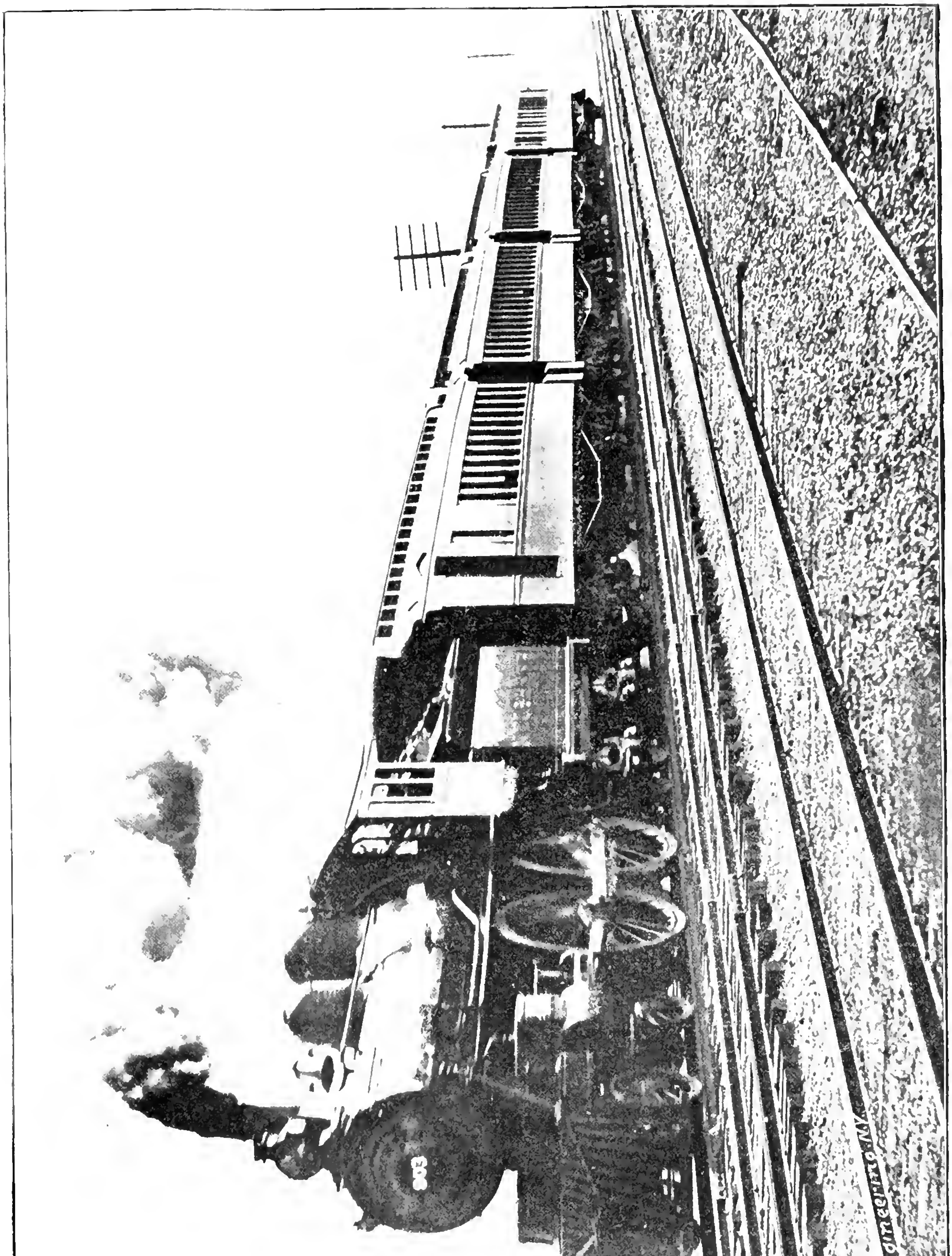
After we got fairly started, the occupants of the train settled down to amuse themselves, just as if we were passing over space at the rate of 30 miles an hour; and unless those on board had been aware that high speed was in prospect they would not have been conscious of it from the smooth manner the train moved along. The time-keepers sat in a row, watches in hand, listening for the call of another station, and many a keen look was cast over their shoulders to note the time elapsed since the last station was passed. Several stop-watches were constantly in use to identify the time required for individual miles. Mr. E. Van Etten, general superintendent, or Mr. Leonard, called out the stations, and the time-keepers checked each other's figures. This was kept up from start to finish, and left open no chance for mistake. In this respect our run differed from the British railway races, where there was no appointed time-keeper except the ordinary station records.

W. D. Otis, who Controls the Tracks.

Wm. Buchanan, who Controls the Power.

The morning was foggy and the rail slippery. The engine slipped occasionally when lifting the train into speed, but appeared to keep well to the rail when the higher velocities were reached. At 7:54:55 we reached Albany, the run of 143 miles having been made in 134 minutes 25 seconds. This took the train over the hardest division at a speed of $63\frac{1}{2}$ miles an hour. The performance was a feather in the cap of Engineer Buchanan and Fireman A. Elliott, whose skillful labors kept the steam always close to the popping point.

It is not of interest to give in detail all the particulars of the run. At Albany, Engine 999 took hold of the train. By the time she got to the uplands west of West Albany a keen quartering head wind was blowing, which greatly increased the train resistance. It was expected that the



A Snap Shot of the "903" and Train, Near Syracuse, Running Over Seventy Miles per Hour

"999" would break the record. Engineer Chase started out full of vim, backed by perfected engineering skill, but the elements were against him. In the run of 148 miles, made in 140 minutes, he ran about fifteen minutes short of his expectations. When an engine is pulling a load that is equal to her capacity for the speed required in a calm, the engineer cannot be blamed if he falls behind when a twenty-five-miles-an-hour wind is holding him back.

When we had got through the forest of human forms that gave us noisy greeting as we passed through Syracuse, the station was reached, and the train was taken hold of by Engine 903, with Charlie Hogan, the record-breaker, at the throttle. The wind had abated a little, and a splendid start was made from Syracuse, which took the train over 103 miles in 92 minutes, a little over 67 miles an hour. To those watching the record, mile after mile was made in 50 seconds or under, and it was only the loss of time in starting and checking up to take water that took from us a record of 70 miles an hour for a run of 100 miles. About the time the hundred-mile point was reached the wind freshened again, and stiff ascending grades had to be surmounted. When we got over the summit beyond Batavia, where the best speed on record has been made with other trains, there was fleet wheeling in spite of the wind. The stop-watches testified that one mile was run in 45 seconds, which is 80 miles an hour. The S. P. was watching that mile and noted 45 seconds, but the train was sliding along so smoothly that he was thinking something must be wrong with his stop-watch, when another stop-watch user came in from the other part of the car and held up his watch, exhibiting the 45 seconds in triumph.

Between two banks of packed, waving and cheering humanity the train reached East Buffalo at 12:32:26, having made the $436\frac{1}{2}$ miles in 407 minutes 40 seconds, a running speed of $64\frac{1}{4}$ miles an hour.

The locomotives that did this wonderful performance were built after the designs of Mr. William Buchanan, superintendent of motive power of the New York Central Railroad. The "870" and the "903" were built by the Schenectady Locomotive Works; the "999" was built in the railroad company's shops at West Albany. We show a picture of the "870" with the engineer, Mr. Archie Buchanan, and his fireman, Mr. A. Elliott. The "903" is shown on the train, taken by Yates, the photographer, of Syracuse, when the train was running at 60 miles an hour. The "999", which took the middle run, is so well known to our readers, on account of the engraving of the engine which most of them have received, that we do not think it necessary to reproduce the engraving. The engines are all practically of the same general dimensions. They have cylinders 19 x 24 inches, driving wheels about 7 feet diameter, and boilers with about 2,000 square feet of heating surface, carrying steam of 180 pounds pressure.

The New York Central officials are proud of keeping up their record of running the fastest trains in the world, but the run described was not undertaken for mere sentiment. The business men who control the councils of the company wanted to know at what speed a *paying* train could be run—a train equal in carrying capacity to the Empire State Express, which is the best-paying train on the system. The train pulled was 40,000 pounds heavier than the Empire State Express. The inference at the conclusion of the run naturally was, that with 40,000 pounds less weight the engines would have had margin of power sufficient to make an average speed of 65 miles an hour, including stops and the twenty-eight slow-downs. The speed attained, if maintained over the Lake Shore & Michigan Southern, would have taken the train to Chicago in $15\frac{1}{2}$ hours. It was demonstrated that a paying train could be run from New York to Chicago in 17 hours, leaving a safe margin for delays.

The train, leaving out weight of engine and tender, weighed about 175 tons. In this connection it might be well to mention that, according to the most accurate figures obtainable, the West Coast train which ran from London to Aberdeen, 540 miles, in 513 minutes, weighed about 112 of our tons. It consisted of three carriages of the type exhibited by the London & Northwestern at the World's Fair.

In talking about the high train speeds for which the New York Central is noted, Vice-President Webb said that the credit rested principally with two officials—Mr. William Buchanan for designing locomotives equal to the speed, and Mr. W. T. Otis, general road master, for maintaining a track that could keep high-speed trains on the rails. We show portraits of both these gentlemen.

The New York Central Railroad is to-day in advance of any railroad in the world in the facilities necessary for running profitable trains for long distances at an average speed of 60 miles an hour between terminals. The railroad has no heavy gradients, the curves are not numerous, the track and roadbed are in superb condition, and the trains are protected by a perfect system of absolute block signals. The locomotives are more powerful than any passenger engines found abroad, and it is doubtful if engines of greater capacity can be placed on foreign railways, owing to the low bridges and tunnels. Engines of the "999" class have boilers almost as large as they can be made, and the boiler is the measure of a locomotive's capacity. The gage of track limits the boiler on one side, and the height of bridges and tunnels on the other. The New York Central bridges and tunnels are about twelve inches higher than those on the London & Northwestern, which gives the former company an advantage in the size of boiler.

The party in the car consisted of Mr. H. Walter Webb, vice-president, who was the guiding spirit of the trip, the details having been attended to by Mr. A. G. Leonard, his secretary. Mr. George H. Daniels, general passenger agent, was there keenly watching every second gained over past records, and Mr. E. Van Etten, general superintendent, was all over, watching stations and aiding to keep the record straight. Mr. William Buchanan sat generally behind the writer, and displayed great interest in the indications of the stop-watch. When the record dropped below 50 miles an hour, he walked forward and gazed at the engine with a reprehensive look. The speed then invariably crept up.

Mr. W. D. Otis sat on a light chair and looked behind, noting the avidity with which the trackmen returned to their labors after the train passed. He evidently selected the light chair to show that he was not afraid of curve lurches. Although he weighs about 250 pounds his stability was severely tested at several points. After a bad lurch took place he looked very severe and made a note of it; no doubt somebody got it hot afterwards. One of the most interested members of the party was Mr. W. J. Arkell, proprietor of *Judge*, president of the Mt. McGregor Railroad, and leading spirit in a hundred enterprises. He was the leading spirit of this company, too, as far as amusement was concerned. The successful man of affairs had left the worries of business behind, and drew from a rich store of fun and story to lighten the journey. Mr. Arkell's pleasantry made as much impression as the exciting run.

We were honored with the company of Mr. Julian Ralph, the famous journalist, a man whose face denoted strong latent power. Nothing was talked of that he was not prepared to throw new light upon. Professor P. H. Dudley, designer of the most perfect dynamometer car ever built and consulting engineer for the Vanderbilt system, and the writer, completed the party.

At Buffalo, Mr. Webb's car was attached behind the Empire State Express, and the party reached New York at 10:15 P. M. This is the first time on record that people traveled from New York to Buffalo and back the same day.

A. S.

We are in receipt of a copy of the "Universal Directory of Railway Officials," published by the Directory Publishing Co., Limited, of 8 Catherine street, London, Eng. This list contains the names of some 8,500 chief officials of railroads all over the world, and is well worth the modest price of $2.50 asked for it. Like all annual lists, it must, of course, suffer in accuracy from the constant changes of officials, but it is as accurate as any work of the kind can be, and its field is much larger than any other list.

More Facts About the British Train-Racing.

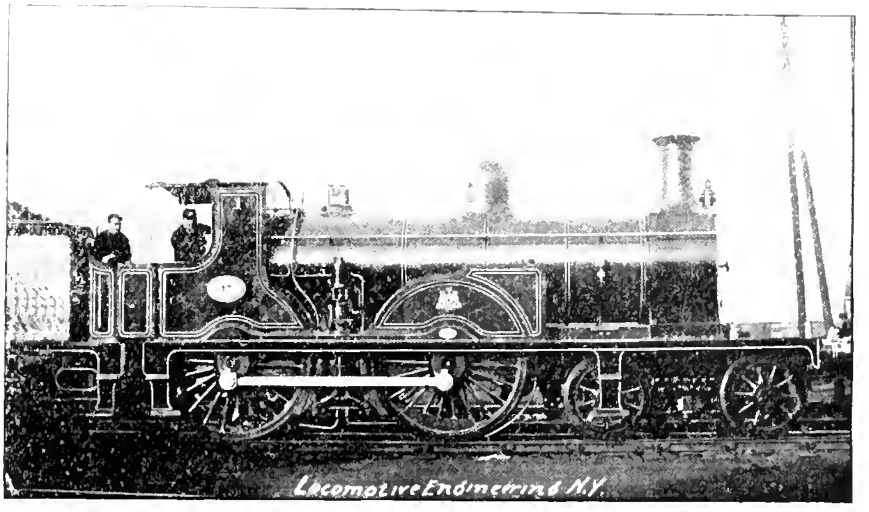
In our September issue we gave all the particulars we had received of the fast running made by the rival East and West Coast routes of England in their rivalry to reach Aberdeen, on the east coast of Scotland, each in advance of the other. Since the article was published we have received through the kindness of Mr. S. A. Forbes, one of our correspondents in Perth, Scotland, a photograph of the engine that made the fast run from Carlisle to Aberdeen, with engineer and fireman at their posts. This engine we illustrate herewith. This correspondent sends us a true table of the fastest run, which makes out the time between London and Aberdeen to have been 513 minutes.

Within the month our S. P., who was an old associate and friend of Mr. John McIntosh, locomotive superintendent of the Caledonian Railway, received a letter, in which Mr. McIntosh says:

"We are having some rather exciting races with the East Coast to Aberdeen, and cannot lose the opportunity of sending you cuttings from the daily papers, which will give you a far better account of the racing than I could.

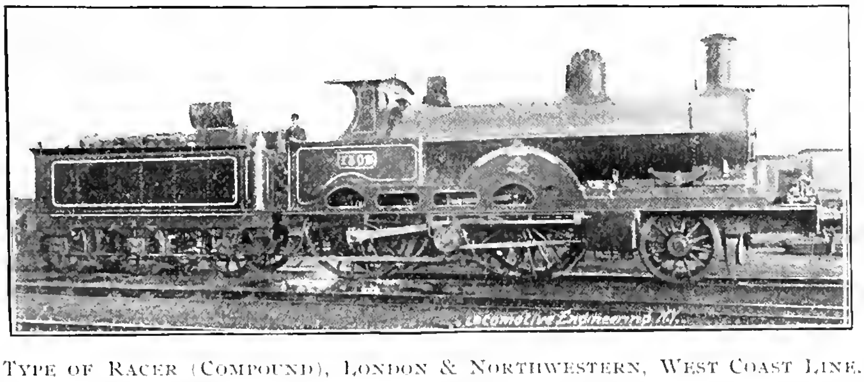
"As you are aware, since the Forth and Tay bridges were opened the trains by the West Coast route have always been from 20 to 50 minutes later in arriving in Aberdeen, and as our morning train (8 P. M. ex Euston) was booked to reach Aberdeen at 7:50 A. M., through delays occurring, sometimes it lost the North connection.

"To obviate this, we shifted our arrival time forward to 7:40, and the East Coast, feeling indignant at this, altered their time to 7:20.



Record Engine, with John Soutar in Charge, Caledonian, West Coast.

Great Northern Eight-Foot Wheeler, with Her Train at Full Speed.



Type of Racer (Compound), London & Northwestern, West Coast Line.

"We could not put up with this, as it was more than we could stand, and we replied by putting our train in at 7 o'clock; they replied by altering theirs to 6:45, we again put ours to 6:35; they put theirs to 6:25, we replied with 6:20; they again reduced their time to 5:40, and we replied by making ours 5:35; they then made a further reduction to 5:13, and to overcome them we put in our train at 5 o'clock, but arrived at 4:58.

"We made no particular arrangement in connection with the railway race, but simply allowed the regular men to take their turn of the train, with the engine they use in ordinary work.

"The engine which made the record is sister of the engine you rode on from Glasgow to Carlisle, and which has done very satisfactorily, although I cannot find fault with what the others are doing.

"We purpose building other ten engines of this class, but they will have larger cylinders, larger boilers, and be altogether more powerful."

Another letter, dated September 5th, from Mr. McIntosh, says:

"You will no doubt be pleased to learn that John Soutar (an old friend) is yet able, with one of these engines, to accomplish the journey from Perth to Aberdeen —90 miles—in 80 minutes. For this unique performance he was presented with the 'Blue Ribbon' and carried shoulder high by enthusiastic admirers on his arrival at Aberdeen Station with the train which had actually traversed 540 miles in exactly 513 minutes.

"The West Coast train averaged in weight from 100 to 170 tons, not including the engine, and on this line the average coal consumption did not exceed the daily average of similar engines working ordinary trains.

"The average consumption of coal per mile was from 33 to 37 pounds.

"I have also herewith sent you a timetable for four days, showing the actual running of the train over the Caledonian system, and you will observe that in some instances the 241 miles were covered in 230 minutes. Of course, you understand that our train had to climb 10 miles of a gradient of one in seventy, which took our engines something like 14 or 15 minutes to get over. This naturally deteriorated our average running, and it does not compare so well with the London & Northwestern for the last or record day of the race. With this exception, however, our average was very much higher than the L. & N. W. during the whole time of the racing period.

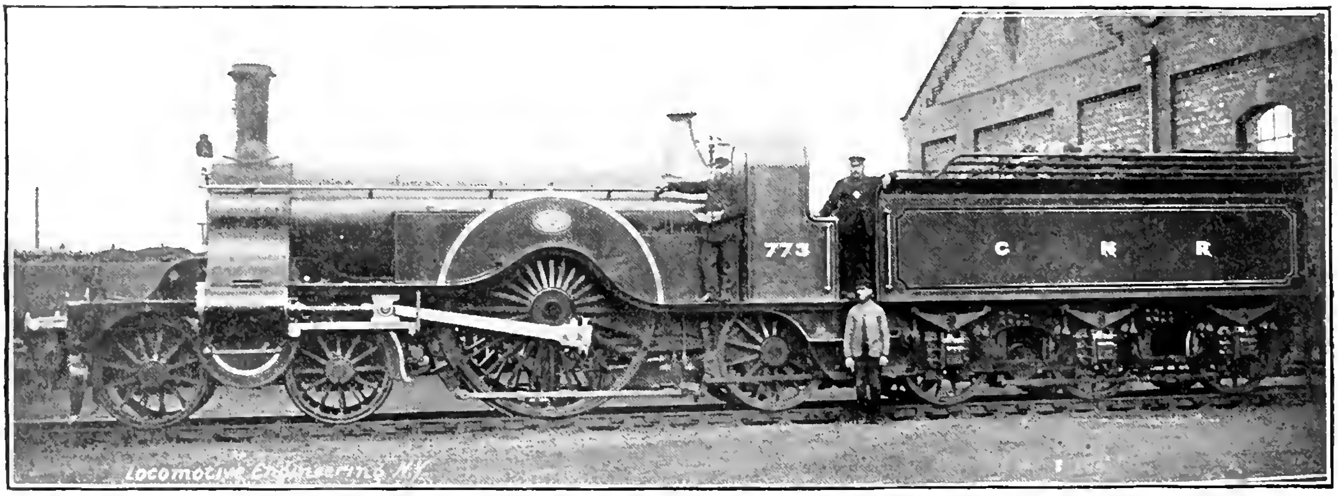
"These particulars, with the details you have already got, will, I think, enable you to see what was actually done.

"During the whole of the racing, I am pleased to say, we had not a single hitch in respect to engines breaking down; in fact, our locomotives arrived at their destination perfectly cool and otherwise in splendid condition.

"Our greatest difficulty was in holding the drivers back, as the running times made were exactly what the men were asked to do, so that we have got something in hand yet should it be required.

"As I get your paper every month, I will see how you express yourself on the subject."

There were features about the racing between the East and West Coast lines that were extraordinary beyond anything ever known since contests of speed began. Both trains started from London at the same hour, from a point less than a mile apart. They ran, as from the stem, along the edge of an elliptic-lanceolate figure nearly 100 miles wide at the middle, to see which train would first reach the point 500 miles away. One train followed a route where the passengers might smell the marine breeze from the Irish Sea, and for a few miles they could see the blue waters of the Solway Firth. The other slanted towards the German Ocean, and for many a long mile ran skirting the edges of the rugged precipices that mark a striking feature of that coast. This line crosses the Forth and Tay bridges, and, near the junction common to both lines, passes over a small arm of the sea at Montrose. The goal, Kinnaber Junction, is only four miles away, and in the last race both trains were in sight of each other for three miles, the East Coast train spinning over a level plain, the West Coast toiling around a hillside on a steep ascending grade. The race would have gone to the East Coast train had it not been that its block began within a mile of Kinnaber Junction, while the block of the West Coast train extended three miles from the junction to Dubton Station. The advantage of two miles enabled the West Coast engine to receive first the permission to enter upon the junction block, and the other train was cut out. Both routes use the Caledonian track from Kinnaber to Aberdeen, a distance of 40 miles, the North British Railway having what is called running powers over that section.



Type of Racer Used By Great Northern, East Coast Line.

Test Globes Used for Signals.

They have a very good plan for testing colored globes for lamps in the store-house connected with the Norfolk & Western shops, at Roanoke, Va. The globe to be tested is placed in the end of a long dark tunnel, alongside of a globe which is of standard density. The man testing the globes sits at the other end of the tunnel and readily detects those which are too opaque or too light.

This system of examining globes was made necessary through complaints that the globes of some red lamps were so light that they were not easily identified as danger signals, and in other cases they were so dark that they were scarcely visible. When a systematic examination of the globes was undertaken, it was found that their color-showing capacity was surprisingly different. All globes or colored-glass disks that do not come up to the standard are now returned at the dealer's expense. Very few have to be returned now. The globes defective as signals are sent to roads where no systematic tests are made.

We are in receipt of a long communication from the supreme secretary of the new order known as the Independent Order of Locomotive Engineers, whose headquarters are at Tacoma, Wash. This is a non-secret educational order, as near as we can judge. It is no longer necessary to make any argument in favor of better mechanical education of engineers and firemen; civil service rules are going into effect that oblige men who run and fire engines to have a little more knowledge of their business than was formerly thought necessary. Air-brake information is now absolutely necessary, and this must be about right. Everybody with horse sense sees this, and the great majority of the men are preparing to meet the examinations; they are reading more than they did, and the men who do not try are fast being retired to farms. The educational era has been reached; it matters not how, when nor where a man gets posted if it is only done and done right. Everything that tends to make this easier is a good thing for the enginemen, the railroads and the public.

At the Fall Brook shops, at Corning, N. Y., they do all their heavy lifting by hydraulics. In the repair yards they have a pair of heavy cylinders hung on a bridge, to lift box cars with. These cylinders are encased in square wooden boxes, and below each box there is hung a lantern, with its top projecting through into the box—this prevents freezing in winter.

Accident Prevented by Good Brakes.

"We are keeping on steadily applying air brakes to our freight-car equipment," remarked a leading official of one of our most important trunk lines, "and we are already finding that the expenditure is a paying investment. It pays in several ways," he continued. "We are using air-brake cars on all our fast freight trains, and we are getting them through with a regularity and promptness never before experienced. There are fewer wrecks and small breakages, which do so much to delay trains and demoralize the traffic."

Getting warmed up to the subject, he said: "I can tell you of a case that shows what may be called the indirect benefit of having freight trains under full control. A stock train of thirty-five cars was following a passenger train as closely as the blocks would permit. When starting from a station the passenger train was stopped by a fractured hose. The block that the passenger train was on was approached on a curve which made the signal visible on the fireman's side. He made a mistake and called out that the signal was off, when it was set against the train. The engineer kept going at a speed of about 40 miles an hour, and he was within about 1,000 feet of the passenger train before he perceived the danger. He instantly used the emergency application of the brakes, and every car on the train being braked, the engine stopped within 50 feet of the passenger train.

"Had that happened with the same train hand-braked," said this official, "the engine would have plowed through four or five of the passenger cars. I reckon the brakes saved this company $200,000. That pays for a good many brakes."

A Hot-Pin Compound.

Claude Ayers, the well-known Union Pacific, Denver & Gulf engineer, has a pet compound for hot pins and journals. It is such a "cooler" in the sandy wastes of the Southwest that its compounder has occasion to write the receipt for every other engineer he meets. Here is the receipt in full, and we have the assurance of those who have used it that it is a good thing:

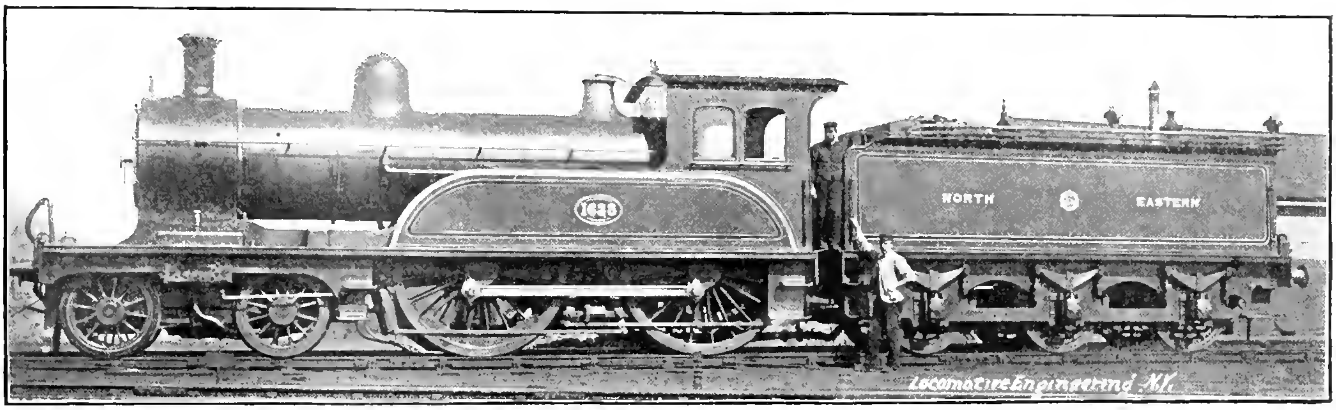
½ lb. lye (concentrated).
½ lb. plumbago.
6 lbs. tallow.
4 lbs. valve oil.
¾ lb. beeswax.
1 or 2 sperm candles.

Boil lye in one (1) pint of water until thoroughly dissolved, then add the plumbago and get it well mixed; melt the tallow, beeswax, sperm and valve oil together, then mix the whole batch together and boil 30 or 40 minutes; stir while boiling and while cooling. To be used in grease cup or by putting a little with oil in an ordinary rod cup.

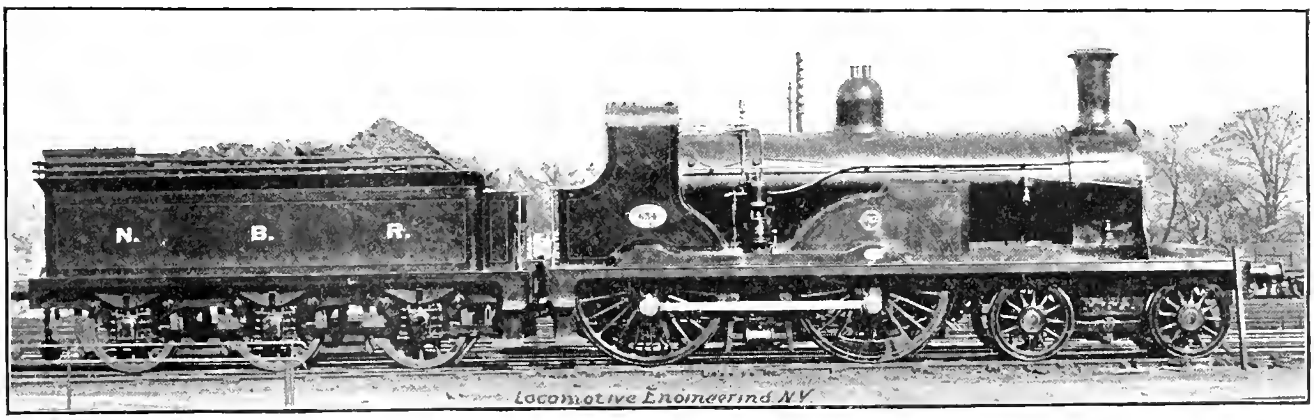
Riveted Joints.

While visiting the drawing office of a large railroad, lately, the writer found the chief draftsman working out the design of a new boiler for high pressures. A detail which was giving him some perplexity was the form of joint to be used in the longitudinal seam. He had drawn several kinds of butt-jointed seams and figured out the strength, and none of them was quite satisfactory. On being asked why he did not look up the joints recommended in a report submitted to the Master Mechanics' Convention, he admitted that he forgot that such a report had ever been made.

We mention this incident because it is an illustration of how sources of valuable information are sometimes neglected or overlooked. That report on Riveted Joints is a compendium of the best practice in the form of boiler joints, and its recommendations may be safely followed. Not only are illustrations given of the best kinds of joints and figures of their efficiency, but good object lessons are shown of joints which ought not to be used. We would direct the attention of every one responsible for the designing of boilers to the valuable information in the report referred to. By carefully studying the facts given therein they would probably avoid making mistakes that are liable to prove both dangerous and expensive.



TYPE (COMPOUND) USED BY THE NORTH-EASTERN, EAST COAST.

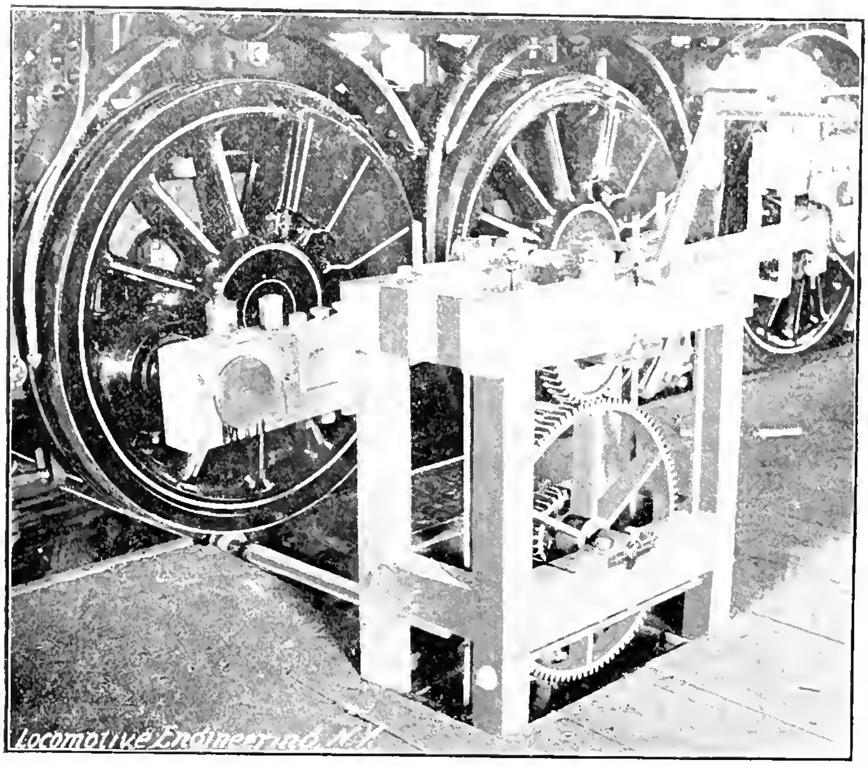


TYPE OF ENGINE USED BY THE NORTH BRITISH, EAST COAST.

Device for Moving Drivers While Setting Valves.

It is unnecessary to waste words describing a device that is so fully explained by an engraving such as this one is.

This device is used at the Buffalo shops of the Western New York & Pennsylvania road, and was designed by Mr. Allen Vail, superintendent of motive power, to save labor.



DEVICE FOR REVOLVING DRIVERS WHILE SETTING VALVES, W. N. Y. & P. RY.

The roller device sets into a recess in the rail and can be handled very closely by the geared arrangement shown.

Increasing the Capacity of Motive Power.

The Pennsylvania Railroad Company are to-day reaping a curious benefit that has come to the system by the pressure of the hard times. When business was good, this company suffered chronic inconvenience from being short of power. When the depression of business came on two years ago, the necessity for closing up every possible channel of expense that was not imperative became the policy of the road. Among the lines of saving undertaken was the moving of trains with as few locomotives as possible. This led to radical changes in the methods of moving trains. A variety of track improvements which reduced the delays of trains on the road were carried out also within the last two years. The result has been that the time of getting freight trains over the main line has been reduced about one-third.

Since the panic, the company have built very few new locomotives. The business on the road is now heavier than it ever has been, and naturally the company should be short of power. Instead of that, however, they have locomotives stored, waiting till they be needed—a result due to the improved arrangements for making the engines do more work, and to the increased track facilities.

Air-Blast Cushion Cleaner That Carries the Dust Outdoor.

Six years ago this paper explained the working of an air blast to clean coaches and sleeping-car interiors, as then used on the U. P. road, at Portland, Ore., where, we believe, it was first practiced.

Since that time hundreds of division terminals have fitted up plants for doing the work this way.

There have been some improvements in the shape of nozzles that opened the pile of the plush, but nothing has heretofore been devised that got rid of the objection to using a jet in cars, which was the tendency to stir up a great deal of dust that was not removed, but found its way again into the plush of seats and back and other parts of the car.

Almost everywhere that air is used the seat cushions are removed and treated to their air bath out in the yard, but backs cannot be so treated.

At the Dubuque shops of the C., M. & St. P. they *suck* the dirt out of a car and deliver it outside. They clean backs as well as seats, and there is not a speck of dust stirred up inside the car.

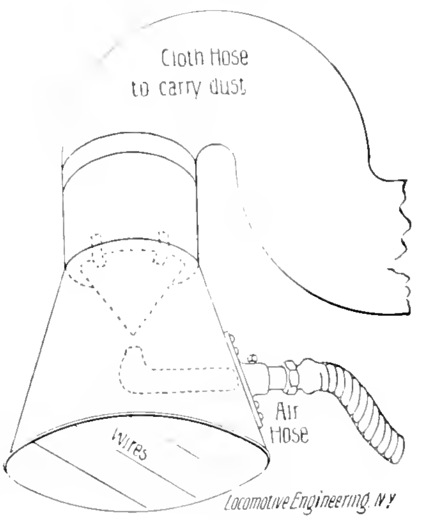
Our sketch shows the simple device used for this purpose. An inverted funnel is used on the plush; across the opening of this are fixed three or four wires that, as the device is moved over a cushion, open the pile.

The air jet is only $\frac{3}{4}$ of an inch in diameter (but this is because they are limited as to pressure and volume of air); this strikes a cone, as shown; this cone fills the $2\frac{1}{2}$-inch top of the funnel within $\frac{1}{8}$ of an inch all around. As a vacuum creator this is a great success, and the way dirt and air mingle and travel through the large canvas hose is a caution.

When started on a set of seats that have been dusted in the ordinary way, the discharge from the cloth hose looks like a stream of liquid dirt. The hose is about four feet long—just enough to reach well out of window when being used on a seat.

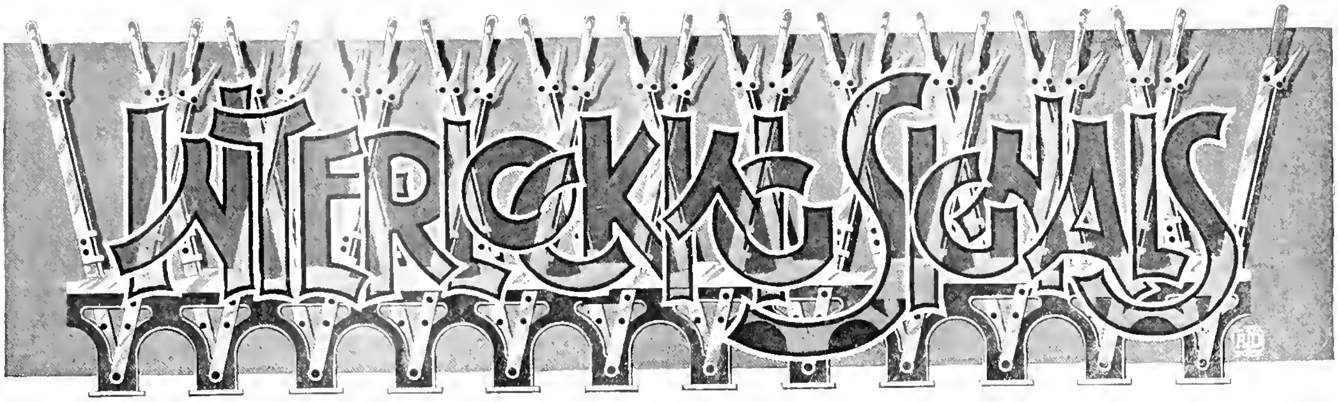
For cleaning carpets, or, in fact, any fabric, this device cannot be beaten for speed and results. We advise all our friends now using the air jet to make one of these *exhausters* and try it. The results are more than satisfactory. We are indebted to Mr. George Brown, M. M., at Dubuque, for information about this device.

There appears to be much conflict of evidence about the merits of brass driving boxes. The Pennsylvania and several other railroads that have tried brass driving boxes largely have returned to cast iron, while the New York Central, which is using Ajax metal driving boxes for the heavy fast engines, reports them to be giving entire satisfaction. Those using ordinary brass say that when a box once gets hot it never runs cool again.



CUSHION CLEANER.

All the Western railroad men are talking of a fast run recently made on the Wabash. Their east-bound fast mail left Kansas City late, but reached St. Louis on time. Between Montgomery and Gilmore the run of 42 miles was made in 39 minutes, and the 18 miles between Truesdale and Gilmore were covered in 14 minutes. This is equivalent to a speed of 77 miles an hour. The train was hauled by Engine No. 319; engineer, Barney Burke. Burke is a well-known young runner, and has been for the past three or four years traveling engineer of the road. Wabash tracks and power must be in pretty good condition.



By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

For Junction Points and Drawbridges—Construction of the Improved Saxby & Farmer Interlocking Machine.

[TENTH PAPER.]

Junction points, like crossings, unless protected, are dangerous places for trains to run by without first making a stop, not only because the switch may be wrong, but because a train may be approaching on the other track that will also want to use the junction switch. By interlocking the switches, providing signals to govern the different routes, and by putting in derails to enforce obedience on the part of the trainmen to the indication of the signals, there

1—2 W 5.
2— 5. 5.(3 W 5).
3— 6. 6.(7 W 6)
4— SPARE
5—
6— FIG. 1
7— 6.
8— SPARE
9— 5, 5.(2 W 5).
10—6.(7 W 6). 3.
11—(10 W 6).(9 W 5).
12—(10 W 7).(9 W 5).

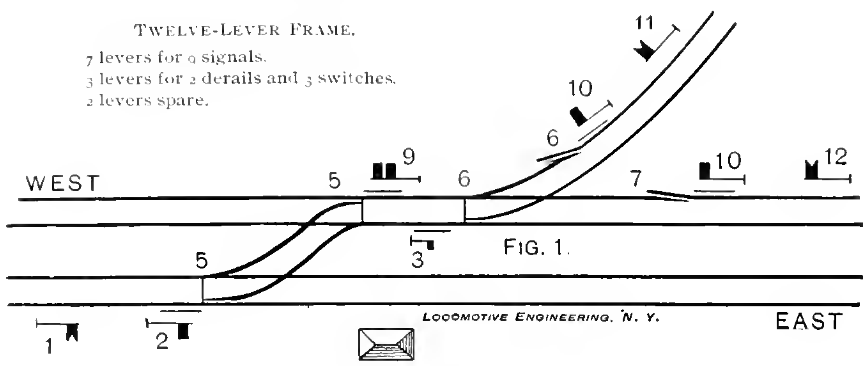
will be no necessity for any train's stopping, unless it be to register or to get orders, as it is practically impossible for the signalman to make a mistake and set the switches and clear the signals, so as to permit two trains to come into collision with each other.

In a previous article the signals necessary to govern a simple switch or junction point of two tracks were shown, and while the same general plan of signaling is followed in all such installations, the particular arrangement of the signals will vary with each location.

In Fig. 1 a junction of a single with a double track road is shown, cross-over switches being provided to allow trains to run on to the single track from either of the other two. It will be noticed that two signals are provided for all facing-point switches, or those where it is possible for a train running in the normal direction of traffic, either to keep to the main line or to take the switch. In these cases the upper blade governs the high-speed route, or is the one that is "cleared" when the switch is set for the main line; when the switch is set for the cross-over, the lower blade is the one that governs. The junction switch, or the one numbered 6, is used both as a facing and a trailing point; but as it is normally a trailing point, it must be so signaled, a single-blade dwarf signal being used to govern trains going on to the branch line, while the two signals numbered 10, which govern

TWELVE-LEVER FRAME.

7 levers for 9 signals.
3 levers for 2 derails and 3 switches.
2 levers spare.



INTERLOCKING SIGNAL FOR JUNCTION OF A SINGLE WITH A DOUBLE-TRACK ROAD.

the switch in the normal direction of traffic, are of the standard semaphore pattern.

As the two signals which govern the switch in the normal direction of traffic should never be cleared at the same time, they can both be connected to and worked by the same lever in the machine, a selector being used to connect the proper signal with the lever, the same as if they were both on the same pole. It is for this reason that they both are numbered 10. The only derails necessary are those on the branch and on the main line, just before reaching the junction switch, where, if a train should run by the signal, it might run into another train, should it happen to be using the switch at that time. Derails are not necessary at any other point, as there are no other switches upon which a train might come into collision with some other train, should the signal be run by when at danger. Any train running by signals Nos. 2 or 7 when at danger would only be going in the normal direction of traffic, so that no collision, which the interlocking was designed to prevent, could happen. Interlocking signals are not intended to prevent collisions between two trains running in the same direction, as that is the province of a block signal, and not of an interlocking plant.

The locking required to make the operation of the plant safe is somewhat more complicated than any of those which have been given, as there are a greater numbe of levers that have to be locked when the signals governing the different routes have been cleared.

For instance, lever 2, when reversed, must lock lever 5 both ways, normal and reversed, as lever 2 clears the signals for either route. It must also lock signal 3 reversed when cross-over switch 5 is reversed, to make it safe for a train to run on the other track. For, as lever 3, when reversed, locks the levers controlling the route on the main or the branch line in the proper position for a train to proceed in either direction, lever 2, when reversed, practically locks all the levers of the route indicated, making it safe for a train to proceed through the limits of the interlocking.

The distant-signal lever No. 1, when reversed, locks lever 2 reversed with lever 5

normal. This prevents the clearing of the distant signal when signal 2 is cleared for the cross-over or the slow-speed route.

The combinations of levers to be reversed to give clear signals for the principal routes, or the "Combination Sheet," as it is called, are as follows:

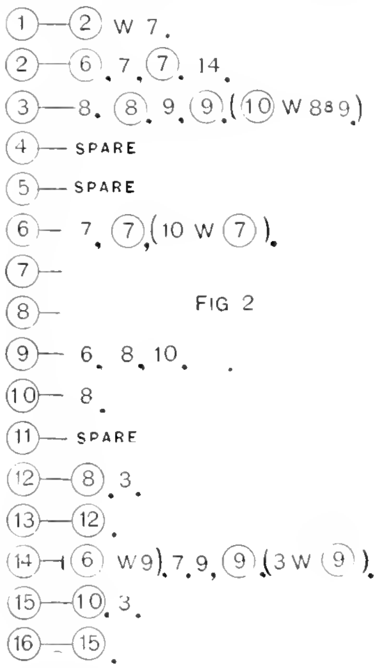
Main track, east bound, 2, 1.

Main track, west bound, 7, 9, 10, 12.

East bound, main to branch, 6, 5, 3, 2.

Branch line to west bound main, 6, 9, 10, 11.

The signals and derails necessary to make the use of a junction of two double-track lines safe, so that trains need not stop unless the signals have been cleared for some other train, are shown in Fig. 2. The signals required are much the same as those shown in Fig. 1, but it is necessary



to use one more derail, so as to protect trains that use the cross-over and back over on to the west bound main line. A dwarf signal (No. 14) has also to be put in to govern trains making this movement.

In working out the locking of the levers necessary to make the operation of this plant safe, there are several points to which attention should be called. As it would be unsafe for a train to use the cross-over switch if it were possible for the signalman at the same time to close any one of the derails, lever 9, when reversed, must lock levers 6, 8 and 10 in the normal position. Lever 6, when reversed, must lock lever 7, both in the normal and the reversed positions, to prevent that lever being thrown after 6 is reversed. Lever 6 must also lock lever 10 normal, when lever 7 is reversed, to make it impossible for two trains to come together where the two tracks cross each other.

It is also to be noticed that the signal levers in all cases, when reversed, lock the levers of the signals governing the opposing route in the normal position, so that it is impossible for the operator to give clear signals to trains running in opposite directions, that would come into collision with each other.

The "combinations" of the levers for every movement provided for by the signals are as follows:

East bound main, 6, 2, 1.

West bound main, 10, 15, 16.

East bound main and branch, 7, 6, 2.

Branch to west bound main, 8, 12, 13.

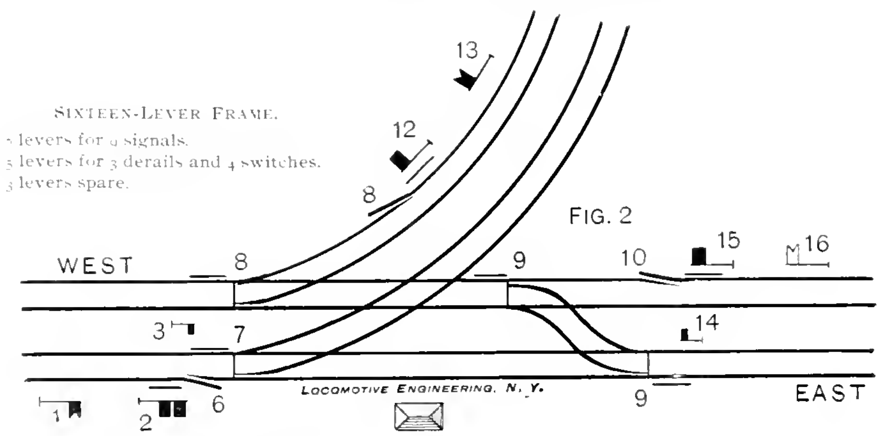
East bound to west bound main, 9, 14.

West bound main to branch, 8, 3.

West bound main to east bound main, 9, 3.

West bound main against normal direction of traffic, 10, 3.

At drawbridges it is just as necessary, or even more essential, that all trains be brought to a stop before passing over the bridge, than it is at a crossing, from the fact that the draw might be open, or opened when the train was too near to make a



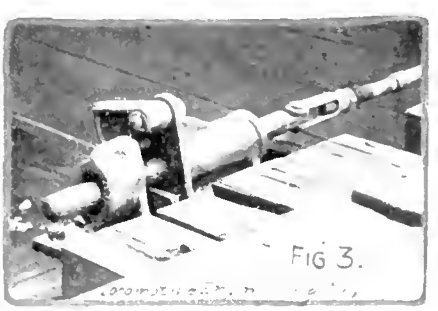
INTERLOCKING SIGNALS FOR JUNCTION OF TWO DOUBLE-TRACK ROADS.

stop, in which case a worse accident than a collision would be very likely to happen.

Protection and safety in the operation of drawbridges, without requiring trains to make a stop, are afforded by the use of interlocking signals in the same manner as with a crossing of two single tracks at grade, and in most cases this is a very simple matter. Each approach to the bridge is provided with a home and, where necessary, a distant signal; derails being put in to throw a train off the track if the indications of the signal are disregarded. The distances these are placed from the ends of the draw should in all cases, except for a very slow-speed route, be at least 500 feet, owing to the distance it is possible for a train to run on the ties after being derailed, should it be running at even a moderate rate of speed. All switches that are between the home signals and the bridge must be connected up and properly signaled, to prevent a signal from being cleared when it was not safe for a train to proceed. The numbering and arrangement of the levers are the same as that used in the plan of a simple crossing.

It is usual to put the interlocking on the draw itself, so that the levers operating the locks of the bridge may be interlocked with the other levers, making it impossible to unlock and turn the bridge while the couplers at the end of the bridge, which make the connection between the levers of the machine and the switches and signals, are closed. As these can be uncoupled only when the signals are at danger and the derails open, it is impossible to make a mistake and allow a train to run into the open draw.

Where the machine is not placed on the bridge, a separate lock has to be provided, which will make it impossible to close the derails on the track leading to the bridge, unless the bridge is in its proper position. This lock is shown in Fig. 3. The end cap, which prevents the plunger from being shoved out when the bridge is open, being moved one side by a lug on the socket casting when the bridge is closed, allows the signalman to reverse the lever and lock the bridge, when the other levers may be reversed. Where the approach to a drawbridge is such that a derail cannot be used, owing to the fact that there is no place in which a train can be derailed without entailing great damage, interlocking the bridge and providing the necessary signals do not make

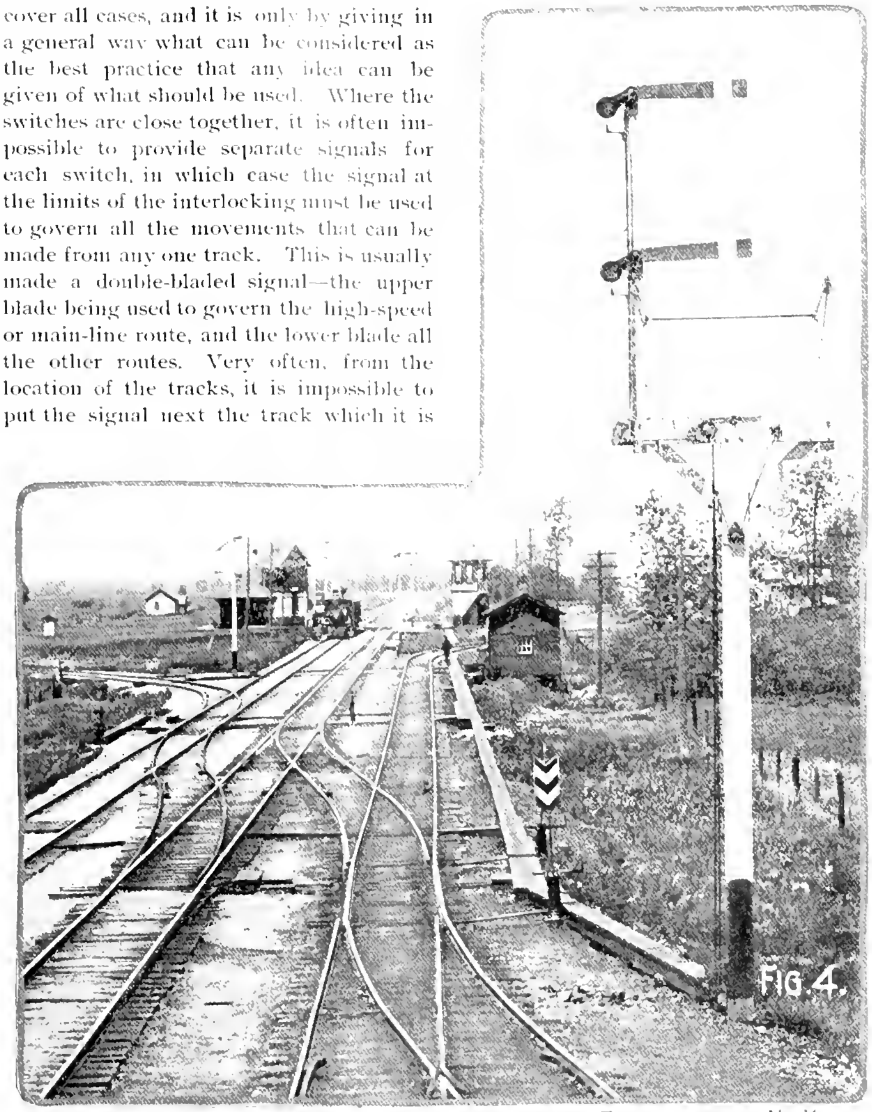


A BRIDGE LOCK.

it safe for trains to use the bridge without first making a stop, as there is nothing to bring the train to a stop should the engineer run by the signal.

In signaling complicated crossings, terminals, or sets of switches, the method pursued is, in the main, the same as that followed in protecting the simple locations that have been described. As each plan will differ somewhat from that of the

other, no rules can be laid down that will cover all cases, and it is only by giving in a general way what can be considered as the best practice that any idea can be given of what should be used. Where the switches are close together, it is often impossible to provide separate signals for each switch, in which case the signal at the limits of the interlocking must be used to govern all the movements that can be made from any one track. This is usually made a double-bladed signal—the upper blade being used to govern the high-speed or main-line route, and the lower blade all the other routes. Very often, from the location of the tracks, it is impossible to put the signal next the track which it is intended to govern, one or more tracks intervening between the signal pole and the track to be governed. In cases where there is but one track intervening, it is customary to use a bracket pole, a mast being provided to represent each track, with the signal blade placed on the one corresponding to the track to be governed. Such a pole is shown in Fig. 4, it being made somewhat higher than the ordinary pole, to allow of the signals being easily seen over the top of a train passing on the intervening track. Such an arrangement is objectionable, as the force of the signal is very much lessened by being placed so far away from the track which it is intended to govern; but as in most cases there is no cheap way of providing sufficient space in which the ordinary signal can be placed, the bracket pole will have to be used. The practice on the Pennsylvania road, however, is to separate the tracks, wherever possible, and place each signal next the track it governs—a practice to be recommended if the matter of expense is not to be considered.



LOCOMOTIVE ENGINEERING, N. Y.

A BRACKET POLE.

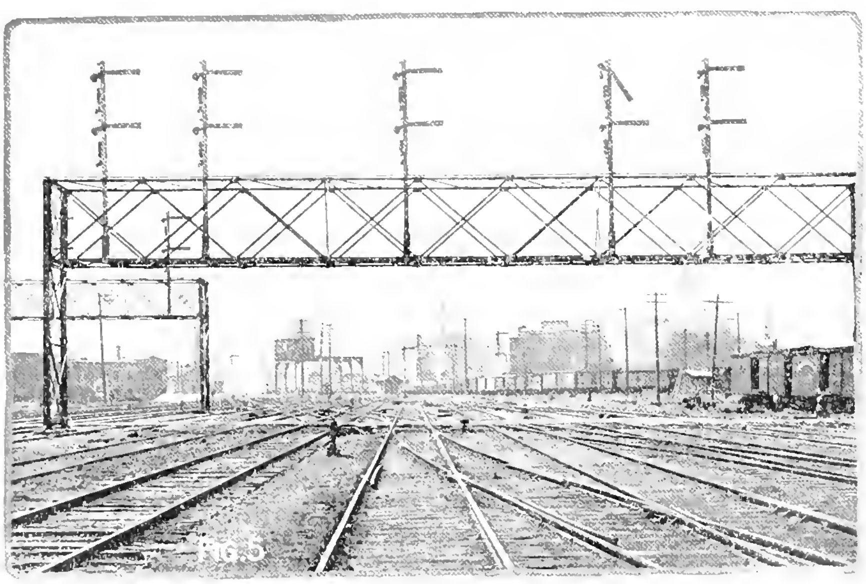
It is claimed by some that a bracket pole is a useless expense, and that an ordinary pole will answer in most places where a bracket pole is now used, for the reason that a high-speed route only would be governed by a high semaphore signal, and that there would be no other high signal for an engineer to see, no matter how many tracks intervened between the high-speed track and the governing signal.

Where but one track intervenes, and traffic on that track is in the opposite direction to the way the signal reads, there seems to be no valid objection to such practice, as at night it is practically impossible to tell at any great distance whether the signal is on a bracket or an ordinary straight pole.

Where more than three parallel tracks have to be signaled, a bridge on which the signals can be placed is almost a necessity. This is an expensive arrangement, but an ideal one, as each signal can then be placed immediately over the track which it is intended to govern. This arrangement is clearly shown in Fig. 5, which is a photograph of the one used at Stewart avenue, Chicago—one of the most complicated crossings in America.

In signaling terminals, a plan that is often followed, where the tracks are close together, is to use dwarf signals in all cases, whether for a main line or for a siding. As all movements are made at slow speed, these answer the purpose just as well as the high semaphore, and are much cheaper. Another advantage to be gained by their use is that they may be always put in their correct position—that is, on the right-hand side of the track which they are to govern—for where there are many tracks to be signaled, it is very easy to see how confusing it would be, if not impossible, to tell which was the proper signal, if some systematic arrangement such as this were not followed in locating the signals.

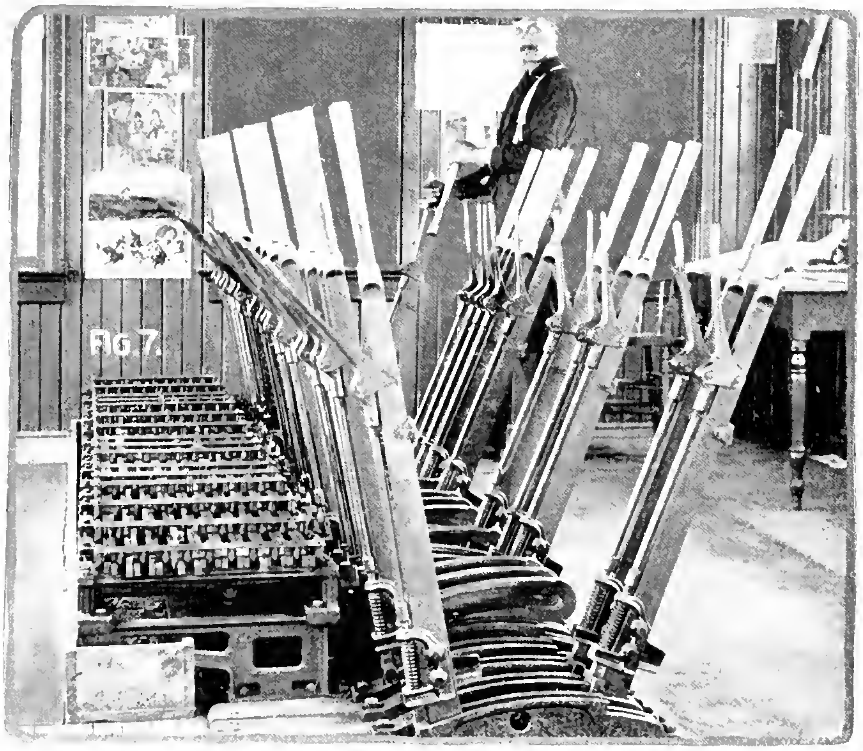
At terminals or yards where movements are made at comparatively slow speed, it is not customary to provide derails to prevent trains coming into collision with each other, but reliance is placed upon the trainmen that they will obey the signal.



Experience has demonstrated that this is a safe arrangement, much more so than where no interlocking is used, and switchmen are employed to work the switches and to signal trains.

Where trains run on the left-hand track, as is the case on several roads in this country, the signals, to be next the track they govern, have to be placed on the left-hand side. This running of trains on the left-hand track is a very bad arrangement, if consistency is to be observed in the location of the signals, as the practice regarding which signal is to be used to govern a given track will vary on different roads.

In England, where all trains run on the left-hand track, the signal blades project to the left, as seen from an approaching train, and are placed on the left side, so that the signals governing any one track are as easily picked out as are those where the signals projecting to the right govern trains running on the right-hand track.



SAXBY & FARMER MACHINE—SIDE VIEW.

Generally, in signaling yards or at crossings, the signal engineer, instead of being consulted as to a good and economical arrangement of tracks while yet there is time to suggest any improvements or a better location, with a view to putting in an interlocking machine, is given a plan of the tracks and asked to signal it, no matter how bad the arrangement may be, after once being made safe, for the movements that are to be made over them.

As the signals that will be required for any given arrangement of tracks, to make the use of the same safe for all trains, is governed by the location of switches and crossings, it follows that it is exceedingly important that these be placed so that the different routes will be separated as much as possible, the switches and signals being located so that movements covering more than one route can be quickly made, allowing one of the tracks to be cleared for other trains. If the arrangement be carefully worked out with this end in view, fewer switches and also fewer signals will be needed, the first cost and the cost of maintenance being much reduced.

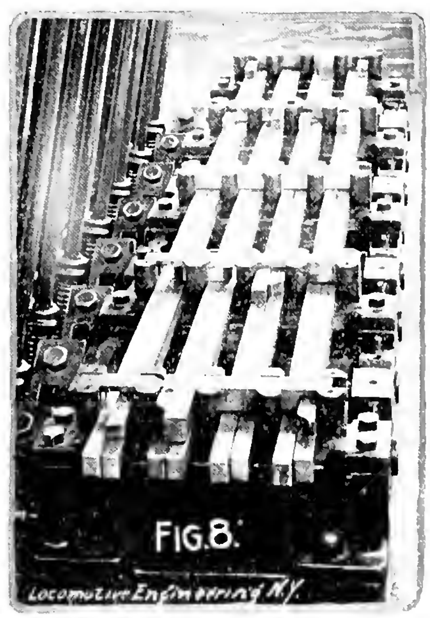
Having outlined the manner in which different arrangements of tracks are signaled, and shown what locking of the levers is necessary to make it impossible for a signalman to make a mistake and pull a wrong lever, it will be best, before describing the different parts used in connecting up the switches and signals, to explain in detail the construction of the different interlocking machines, and show how the locking of the levers is accomplished.

As has been previously stated, the levers of the earlier machines were interlocked by connections made directly to the levers themselves. This resulted in severe strains being put upon the locking, as a signalman would not know, in case the lever pulled hard, whether it was being held by the locking or by the outside connections. The improvement made in the modern machine consists in attaching the locking mechanism to the latching device or latch rod, so that, unless the locking is set for the lever to be reversed, the latch cannot be lifted, and the lever, of course, cannot be pulled over. By this means, raising the latch to unlock the lever, locks the levers of all conflicting routes, and the levers to be released by the reversal of this lever are not unlocked until the lever has been entirely pulled over and latched. This method of locking is known as "preliminary" or "latch locking," and is the one generally used in this country for any machine requiring eight or more levers, although in England the older form is

THE IMPROVED SAXBY & FARMER INTERLOCKING MACHINE.

still in general use—a machine of 400 levers having lever locking, probably the largest in the world, having been but very lately put in service.

Of the different machines in use in this country there are three different patterns



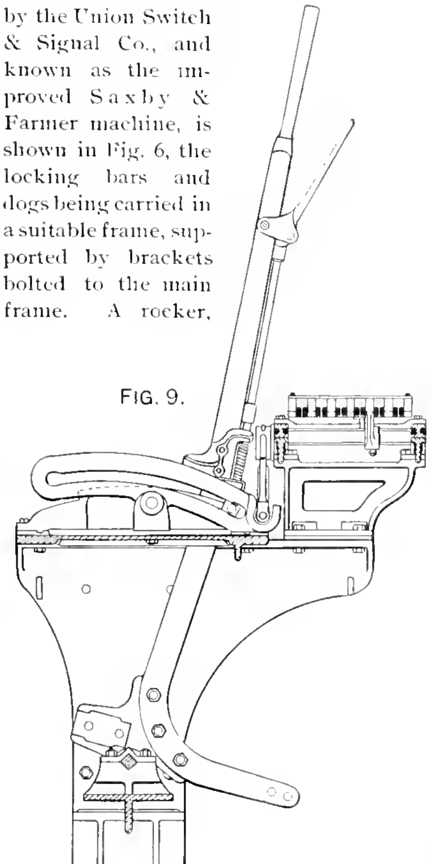
ARRANGEMENT OF LOCKING, SAXBY & FARMER MACHINE.

—that of Messrs. Saxby & Farmer, as made by the Union Switch & Signal Co., and that of Messrs. Stevens & Sons, made by the National and the Johnson Signal Companies. In the main, the different machines are constructed in the same manner and of the same general design; the only practical differences being

found in the manner in which the locking is accomplished and the attachment made to the latch rod. The machines are made so that the levers are centrally pivoted on a main frame; a quadrant being fastened to the top of the frame, by which the lever can be latched in either the normal or the reversed positions. The lower end of the lever is bent out at right angles, to form an arm to which the vertical connection can be bolted. If the connections are of wire, it is necessary that the lever be provided with an arm projecting on the opposite side of the center, to which the back-pull wire can be attached. This arm is called a tail piece, and is usually bolted to the lever shoe or center casting of the lever.

The machine made by the Union Switch & Signal Co., and known as the improved Saxby & Farmer machine, is shown in Fig. 6, the locking bars and dogs being carried in a suitable frame, supported by brackets bolted to the main frame. A rocker,

FIG. 9.



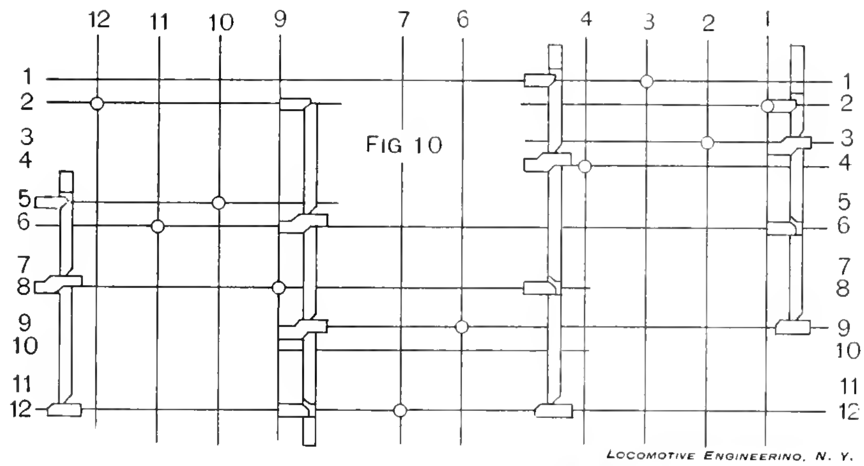
Details of Improved Saxby & Farmer Interlocking Machine.

centrally pivoted, and having a slot in which a projection on the latch may be made to slide, is provided for each lever. Raising the latch to release the lever causes one end of the rocker to be raised; but when the lever is pulled over, no further movement of the rocker is made, as the slot is of the same radius as top of the quadrant. Releasing the latch at the end of the stroke causes it to drop by the power stored in the spring, when that end of the rocker is depressed and the other end still further raised.

This motion is the one made use of in most of the preliminary latch-locking devices, by which the lock rods or tappets can be driven. Motion is imparted to the lock rods by means of a link, used to connect one end of the rocker with a square shaft which revolves in turned bearings underneath the lock rods, and drives them whenever the latch handle is raised or released. The lock rods are carried in brackets, which are also made to hold the locking dogs, the latter moving on top of and at right angles with the lock rods. Lugs with a beveled end are riveted to the lock rods, so as to engage with the dogs in such a way that, unless the dog is free to be moved, the lock rod cannot be moved, and the latch, and with it the lever, will be locked. When one lever, in a reversed position, is to lock another lever, lugs are riveted on each lock rod, and a dog or cross-piece, shorter by the thickness of one lug than the distance they are apart, and having its ends beveled the same as the lugs, is placed in the locking bracket between the two lugs. Making the dog shorter in this way allows one of the bars to be moved, as the dog can be shoved over against the lug on the other bar, thereby locking it, which is just what it was intended that it should do.

This action will perhaps be more clearly understood if reference is had to the diagram (Fig. 10), in which the locking is drawn out as it is arranged on the machine. This diagram is called a "Dog Sheet," and is the working drawing by which the locking, as called for on the locking sheet, is worked out. The long lines which represent the lock rods are numbered, not to correspond with the levers with which they are connected, but in the order in which they are placed, commencing with the one next to the levers. A small circle drawn on this line shows by which lever the rod is worked and where the connection is made. The locking brackets are numbered to correspond with the levers, the locking dogs being stamped with the number of the bracket in which they are to be placed, and also at each end with the number of the lock rod under that end. This is done to make it easy to replace the bars and dogs, if for any cause they are removed from the machine.

It will be noticed that in drawing the dogs they are represented as being placed close up to the lug by which the locking is performed, the clearance necessary to allow one of the lugs to be moved being left next the other lug. The object of this is to make the reading of the dog sheet easy by showing which lever does the locking, and permit of the work being checked up with the locking sheet. Where one lever has to lock two or more levers, the dog is notched for as many lugs as there are levers to be locked, a reversal of the locking lever forcing the dog over against the lugs of the other levers and locking them. If one of the other levers has been reversed, the dog will strike against the lug of that lever, and prevent the lever that locks all the others from being reversed.



Dog Sheet for Saxby & Farmer Machine.

1	LOCKS	2	
2	,,	6	11
3	,,	4	
4	,,	7	9
5		SPARE	
6	,,	7	
7			
8		SPARE	
9	,,	7	
10	,,	9	
11	,,	6	
12	,,	11	

FIG 11.

Locking of Levers for a Simple Crossing.

The locking represented by the dog sheet is the same as that which was given for the levers controlling a simple crossing, or as is shown in Fig. 11.

"Special" locking, or the locking which

A Special Locking.

is to be made by one lever only, when another lever is in a certain position, is shown in Fig. 12. As shown, it consists of a lug of special form, pivoted on the locking bar in such a way that it can be moved sidewise by the two dogs, between the edges of which it projects, and also be moved lengthwise with the lock rod, to which it is attached.

In this position the two dogs act as one, as the clearance space between the lugs is taken up, while if the special lug is withdrawn, it will allow either of the two dogs to be moved and a lever reversed.

Claims are made for this style of locking that "the arrangement of the bars permits of the greatest amount of locking in the smallest space, and since only the dogs, which are short, are driven by impact, the wear is reduced to a minimum; that, by being placed in a single tier, any required changes may be easily made and the bars easily gotten at;" and, also, that as all the bars are in a horizontal position, any wear that may take place, due to the weight of the bar, does not in any way affect the locking. Objections are made to it that, from the locking being arranged in a horizontal plane, the towers have to be made much larger than where it is arranged vertically, and that in places where there is not much room to be had, this objection is quite a serious one.

Juniata Shops.

The fine shops of the Pennsylvania Railroad at Juniata have not yet showed much of the activity that has extended to most railroad shops. Although the transportation business of the road is heavier than it has ever been, the power on hand is beyond the requirements, and quite a number of engines in good condition are stored; consequently, there is little inclination to build new engines. Mr. H. D. Gordon, the master mechanic in charge of the shops, is having a hard time getting work enough to do to keep his force of men together. The capacity of the shops is so great that an order for ten or twelve engines is just a bite that is soon swallowed.

Since the dull times came on he has worked into the manufacture of articles that these shops were not expected to make. One of these is frogs and switches. That work was undertaken to keep some of the tools in motion. It was done, however, in a systematic way, and was executed at such low cost that they are now making all the frogs and switches for the entire system.

They have lately done away with the tank-building shop at Altoona, and all the tanks needed for the Pennsylvania system are built at Juniata. The boiler-making plant is such a perfect one that the surprise is, that the company build boilers in any of the other shops when this establishment is not run to its utmost capacity.

An operation largely carried on in these shops that is very interesting to a mechanic is the flanging and forming of steel under the powerful hydraulic press. In their locomotive-building, pressed steel is rapidly taking the place of cast iron for all kinds of casings, covers and parts where strength and lightness are desirable. They have learned a great deal here about the behavior of steel under dies, since the plant was started, and the information often came in the form of surprises. Very often the steel did not come out in the expected shape. The lesson of experience has led them to experiment with lead before they make a costly die of a new form. Cold lead acts under pressure exactly the same as hot steel. They make dies and formers of hard wood, and try them on lead. If the form is not right, changes are made until the required shape is produced. Then iron formers are made.

They have a practice in the hammer shop here which is worthy of imitation. For some reason it is generally considered right to use steam of comparatively low pressure for steam hammers. The hammers here were started with steam of about 100 pounds, and Mr. Gordon did not think they were doing the work they ought to turn out; so he increased the steam pressure to 140 pounds as an experiment, and found that the work was done so much quicker that he made that the regular pressure for all the hammers. A. S.

Pressed-steel oil cans for locomotives are being used on several roads. The long oiler costs one dollar, as against one-third of that amount for tin, but they are strong, have only one seam, and it is believed will outwear several tin cans.

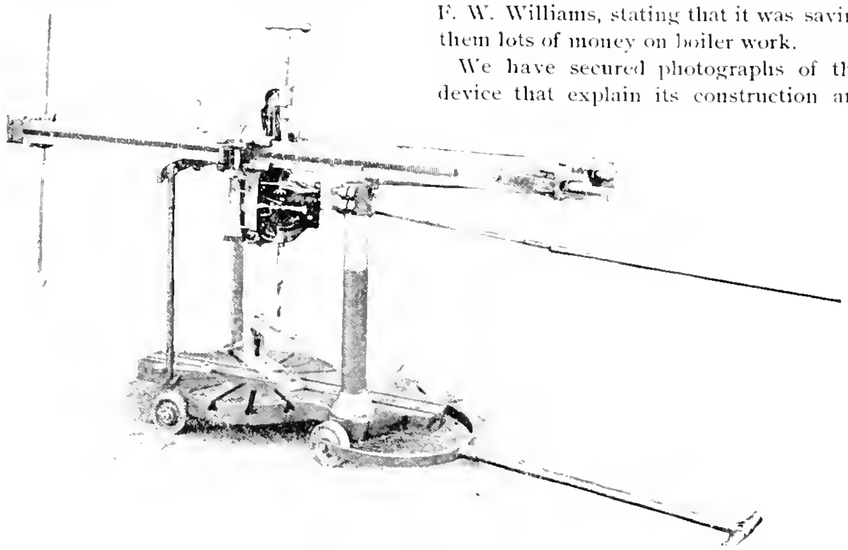
The Smith triple expansion exhaust seems to be making friends everywhere. We hear of its use on new roads almost daily.

A Labor-Saving Drill.

Hard times always mean a squeezing down of shop force and a shortening of the hours of labor. Officers who give these orders are not prone to excuse very marked deterioration of the power and rolling stock, and this causes master mechanics and foremen to try and devise means for reducing the cost of work, saving time, etc.

In a recent letter from Mr. T. F. Clarke, general superintendent of the Minneapolis & St. Louis road, he mentioned this fact, and gave LOCOMOTIVE ENGINEERING credit for doing lots of good in making these time and labor saving kinks known to the railroad world. He called attention to a machine recently constructed at their shops, the invention of the foreman, Mr. F. W. Williams, stating that it was saving them lots of money on boiler work.

We have secured photographs of this device that explain its construction and application, and present them herewith.



USED AS A HORIZONTAL DRILL.

Our larger engraving shows the drill set for drilling out stay-bolts; when used for tapping it sets the length of the tap farther from the work. As a portable drill press it is tipped over on its side, as shown in the smaller picture.

The machine is driven by any suitable power—belt, air, steam or electricity. The power is transmitted by a bevel gear, which meshes into a similar gear on the drill shaft. There are two of these gears, and a reverse lever moves the driver pinion between them. It will readily be seen that to change the gear from one to the other pinion will reverse the motion of the drill or tap, and to leave it midway between them will stop the work without stopping the driving power. This saves lots of time in a day's drilling.

The top of the drill is supported on a heavy pipe held in brackets on side of boiler. The bottom support is the truck bed, in the center of which is a concave groove, and on each side of this groove is a T slot.

In the concave groove a smaller truck carries the upright bars and rolls; a yoke from this small truck projects down, with

lower ends turned out, which pass free through the two T-shaped grooves in the large truck bed. This keeps the machine in an upright position, regardless of the top support, or while moving the machine about the works; or it may be put in a horizontal position, as shown on opposite page.

The upright bars can be set either forward or back to an angle of 15 degrees. The means of raising and lowering the head and fixing the angle of the tool are plainly shown. The machine is handled entirely by one man.

The machine shown in our larger engraving recently drilled 413 stay-bolts in side sheets and back head—holes $\frac{13}{16}$ inch diameter; 60 holes $\frac{7}{8}$ of an inch deep, and 353 holes $\frac{5}{8}$ of an inch deep—at a cost for labor, including placing and removing machine, of $1.99.

The Williams Portable Drill and Tapping Machine Co. has been organized at Minneapolis to put this machine on the market.

A New Idea.

Ike Johnson was called up on the carpet. The "old man" had heard of his running too fast over a pet bridge (the "old man" was the civil engineer of the road and built a lot of bridges, of egg shells, one would think, the way he cares for 'em).

Ike Johnson is noted as the best man on the road, but the "old man" and Ike lock horns on all occasions.

Ike sat down and took his "roast" as quietly as usual, offering no explanations—he knew by experience that it was no earthly use.

"Mr. Sampson," said Ike, dryly, "it's funny, I don't seem to get along with you, somehow; now I've pulled all kinds of trains here ever since the war, and pleased everybody but you; never had a word with another officer on this road—darned funny that I can't seem to suit you."

"You 'tend to your business, Mr. Johnson, and you will suit me all right."

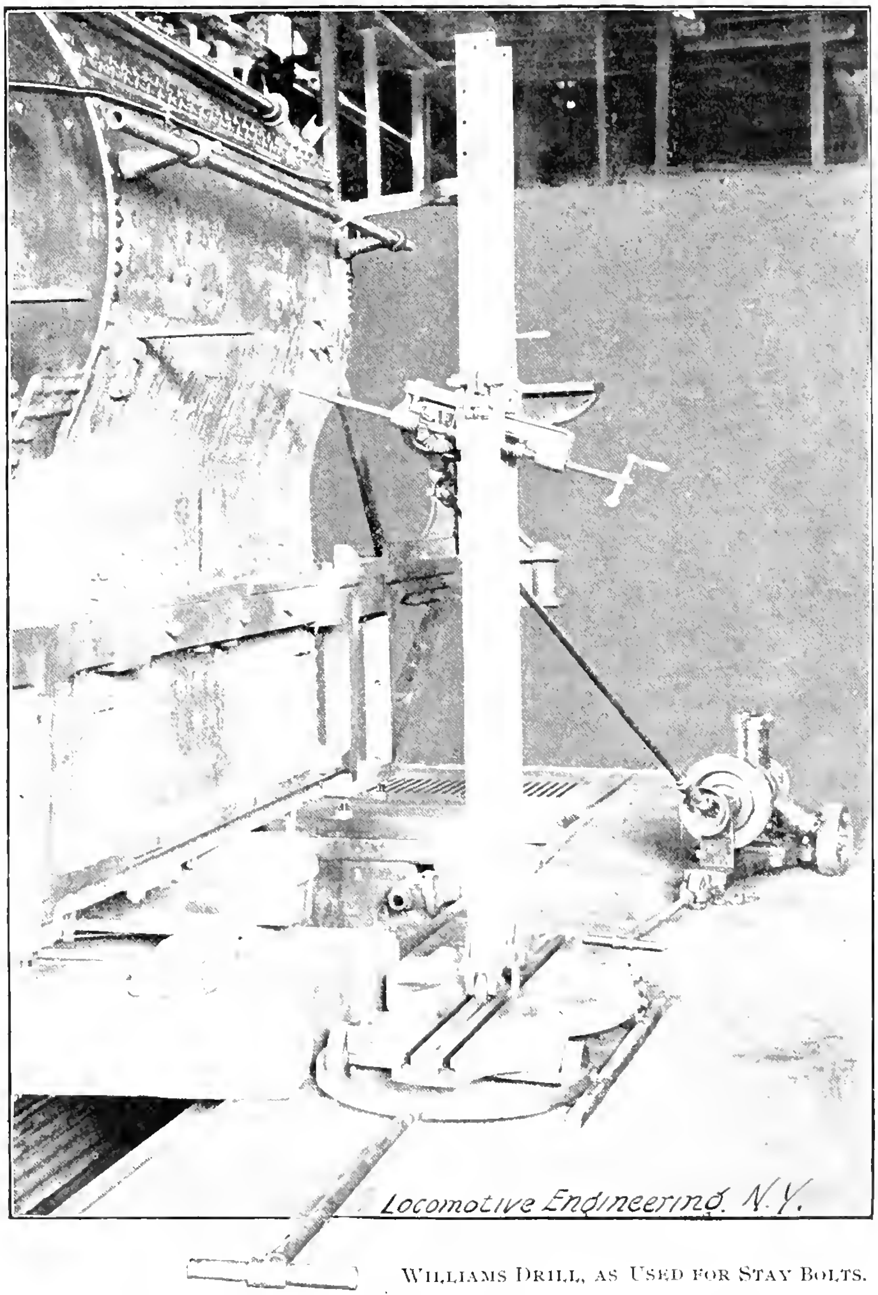
"Ah, yes, yes," mused Ike to himself, "never thought of that before—darned if I don't try it!"

Convenient Storehouse.

The stores department of the Norfolk & Western is managed by the motive power department. The storehouse connected with the machine shops at Roanoke is a model of convenience. Large, well-lighted rooms are used, and they are heated by overhead steam pipes. The racks for storing supplies are arranged across the floor. To economize room, narrow and wide passages alternate between the racks, the wide passage being sufficient for a truck. The shelves in the racks are loose boards, which can be lifted out if more space is needed for bulky material. The bins for holding nuts, bolts and small articles have a sliding front, which facilitates stock-taking as the slide is raised and the contents of the bin raked into a bucket to be weighed. There are drawers in the bottom filled with washers, nails and similar articles, which have an angular bottom which causes the drawer to tip open when the front is pressed down. A man wanting to take out some of the contents, pushes down the front with his foot and the drawer drops open. When he is done he pulls it up and it closes. For stock-taking the drawer is taken out bodily and weighed.

The record of stock is kept by the card system, which enables the storekeeper to tell at a glance how much material of any particular kind is on hand. The supply is controlled by a maximum and minimum account. The maximum allowance must not be exceeded. When the minimum is nearly reached, which the records readily show, requisition is made for a new supply.

There is something infectious about train-racing. When an engineer gets a chance to make the high-speed record that a race gives, there are many others disappointed because they never had the opportunity to show what they could do.



WILLIAMS DRILL, AS USED FOR STAY BOLTS.

An illustration of this happened on the Great Northern Railway of England last month. That line forms the London portion of the East Coast route, and its trains took part in the race to Aberdeen. A few days after the racing was stopped a special train was started from London to carry a doctor 76½ miles. The engineer found his opportunity and took it. He made the run in 68 minutes, showing an average speed of 66 miles an hour, breaking the race record.

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Education of Workmen.

The mechanical engineers of America are, as a rule, men who entered machine shops or factories as apprentices, learned there the practical details of their business, and by mental industry and self-denial studied the scientific principles of their profession when other youths were devoting their leisure hours to amusement and social enjoyment. When we look over the names of the men who have built up the great industries of this country, the men who have developed our iron and steel works, those who have taken the lead in developing our manufactures, we find almost invariably that they began life as workmen, with no other education than that imparted in the common school. We also find that by some means most of them acquired a good knowledge of the scientific principles of their business. A new generation of engineers and industrial leaders is coming gradually to the front, consisting of men who have received a scientific education before acquiring the practical knowledge and experience of their business, and it is likely that the power obtained early in life by the combination of scientific knowledge and practical experience will make college-bred men our industrial leaders in the future. But there will always be some leaders from the class that begin on the hard drudgery of shop or factory and work their way upward. The men who have passed through this ordeal ought to extend a helping hand to those who are forced by grim necessity to follow the same hard road they have traveled.

Education does not make leaders of men, but it is a necessary instrument for him born to be a general. Not all graduates of engineering colleges are gifted by nature to be good managers or superintendents. Only a small proportion possess the talents that commend the possessor to higher work than hewing of wood and drawing of water. About the same proportion is found in the workshop and the factory. The difference in the standing of these two classes is, that the educated man is ready for his opportunity, while the workman has to go through the dreary, hard grind of tedious self-instruction before he is ready for his opportunity.

There have been many noble bequests made in various States for the endowment of schools and colleges to promote scientific education. The facilities for educating day students in all lines of science and art are quite equal to the needs of the country ; but the benevolent friends of education have acted as if there were no boys with masterly natural ability who were prevented by the iron hand of circumstances from attending school after they were able to work. With all our munificence of universities, colleges and scientific schools, our system of night schools or colleges where artisans could acquire the education they require has been miserably neglected. This is the more surprising since so many of our rich men have passed through the hard ordeal of self-instruction. It might be expected that they would be ready to do all in their power to make the path a little smoother for future generations, but they have not done so to any great extent. The founding of the Cooper Institute, of New York, by Peter Cooper, was the noblest act ever performed in this country for the education of artisans. It is sad that so few such places have been established. Nearly every industrial city in the Union is suffering for want of a similar institution.

There is no line of industry among us to-day where the demand for better educated workmen has come up so rapidly as among railroad men, yet those who might be regarded as the leaders in promoting facilities for instruction have been noted for giving no aid. We are daily in receipt of letters telling that the writers have to pass an examination and they want books that will aid them. On most roads they have to stumble along as best they can with their studies. This is a hard ordeal to untrained minds—to men who have received no mental discipline. Very little aid from a teacher would convert mountains of difficulties into small molehills. We write on this subject now because we think that the indifference that exists among leading railroad men concerning the means of education arises from their minds being filled with other thoughts. The demand has become almost general that railroad men shall pass certain examinations before being eligible for promotion, but managers do not feel called upon to help in the educating process that makes a man able to pass the required examination. There is nothing more certain than that railroad companies are the principal beneficiaries—after the men themselves—of the technical education acquired by workmen, and it is not unreasonable that they should be urged to help in establishing night schools and doing something to provide teachers.

At the last Master Mechanics' Convention there was a short discussion about the education of the apprentice boy, and a committee was appointed to report on the Proper Training of the Apprentice Boy. This was a highly commendable action, but another committee ought to investigate the proper training of all railroad men. Both classes need a little of what is known as higher education.

A great obstacle to the establishing of satisfactory night schools for railroad trainmen is that their headquarters are often in small country towns, where it is difficult to find teachers possessed of the technical knowledge desired. Where this obstacle is permitted to stop effort, we think that a correspondence school, on the plan so successfully carried on by the International Correspondence Schools, Scranton, Pa., could be worked to the advantage of the men and of the companies. Under that system, any one who can read and write may become a student. A correspondence school to instruct trainmen on the working and details of train mechanism could be easily worked, and there would be little more labor involved if instruction on train rules were added.

Where satisfactory night schools have not been established, the International Correspondence Schools, of Scranton, Pa., offer an excellent opportunity to the ambitious workman. He may begin with arithmetic and work along as far as mathematics, as inclination leads. If he wants to learn applied mechanics or drawing the necessary instruction will be imparted. He may study steam engineering or almost any other line of engineering taught in technical institutions, and if he is deficient in English education he may improve himself by that line of study. The methods of instruction seem to be suitable for everybody who can read and write. We are personally acquainted with quite a number of men, young and old, who have taken this course, and they all talk enthusiastically about the value derived from the instruction. The young man who is ambitious to be a foreman, and knows little of arithmetic, less of mensuration, and finds the placing of letters in an algebraic formula to be no more intelligible than Greek, must study or remain one of the madding crowd of ordinary workmen. Possession of the technical knowledge of the business is not sufficient in itself to commend him for promotion, but there is a growing tendency to refuse promotion to

those who are not in possession of such knowledge. A man who has not had sufficient perseverance and energy to learn the principles of his business has no right to expect promotion, no matter how good a workman he may be.

Reducing the Weight of Reciprocating Parts.

Within the last year a variety of ably prepared papers and reports have been published concerning the counterbalancing of locomotives, and on the effect that the unbalanced weight swinging round in the driving wheels has upon the track. The persistent discussion of this subject appears to be productive of good, for we find in many quarters a tendency to lighten up the weight of the reciprocating parts as much as possible. The Schenectady Locomotive Works took the lead in this movement, and we now find that the Pennsylvania Railroad and a number of others are doing all in their power to lighten all the parts employed in transmitting power to the crank pin. It is surprising how great the need was for a movement of this kind. Main rods, crossheads and pistons have been increased in weight out of all proportion to the increase of power to be transmitted. In some instances it looked as if the designers did not know just how strong these parts ought to be, and massed the metal into them to make certain that they would not break. What strikes an American traveling in Europe is the lightness of the piston connections of locomotives. For engines of equal size the main rod and crosshead do not appear to weigh much more than half what ours do, yet breakage is very rare. The principal reason for the difference is that designers of locomotives on the other side of the Atlantic are under strict surveillance of the engineers responsible for the maintenance of the permanent way. If an engine was built with the anvil-like rods common on some of our roads, there would be protests raised that would prevent her being used.

The lightening process is devoted principally to the main rod and piston head. The new compound locomotives under construction by the Pennsylvania Railroad have fluted main rods and a single Z-plate piston with two snap rings. The crossheads look as heavy as those on other engines. There appears to be a tendency to lengthen the crosshead, and, therefore, make it heavier, to prevent the tipping movement, which is reputed to be the cause of piston rods breaking. They manage to get along in Europe with crossheads about half the weight of ours, and breakage of piston rods is very rare. This would suggest that the cause of piston-rod breakage is not due to short bearing surface of crosshead.

Most locomotives have their piston heads excessively heavy, but little attention was directed to that until compound locomotives came into use. The common bull-ring piston from 28 to 30 inches diameter is so enormously heavy that something lighter had to be designed, and the single-plate piston began to grow into popularity. There are three forms of single-plate piston, known as the T, Z and U forms, which they resemble. All of them provide a lighter head for the strength required than the bull ring or box piston, and there is very little reason why single-plate pistons should not be adopted for all locomotives. The only objection to them is that the cylinder head must be made to conform to the shape of the piston. The small additional work required to do this ought not to stand in the way of a much-needed reform.

When a movement of this kind once gets started it generally goes on very rapidly, and we expect to see much progress made in the large number of locomotives that will be built within the next two years. The lightening process ought not, however, to be confined to the piston and main rod. The crosshead should receive the attention its weight deserves.

Additions to the Editorial Force of Locomotive Engineering

The Air-Brake Department has already become a feature of this paper. LOCOMOTIVE ENGINEERING is above all things an educational publication, and becoming more and more recognized as such.

The air-brake question became too big to handle in the office—a man needs to be living with the brake to keep up with its improvement. When we commenced to look for an air-brake man the list of experts was gone over, and, shake it as we would, the name of F. M. Nellis would always come to the top.

Mr. Nellis is the air-brake instructor in charge of the Westinghouse Car; his experience is as extended as the boundaries of the country, as he travels all the time, instructing men how to handle the brake in every kind of service; his position enables him to know about all improvements in the apparatus, and his daily experience keeps him posted on all the intricate details of operation.

Air-brake students are requested to make this corner of the paper their headquarters, all reasonable questions will be answered, and the student has the satisfaction of knowing that the answers are from the foremost instructor in the land.

On the first of October, Mr. Orville H. Reynolds, until now mechanical engineer of the Northern Pacific road, will take a place on the editorial staff of this paper. Mr. Reynolds is widely known as the author of "Simple Lessons in Drawing" for apprentice boys and mechanics; he is an instructive and interesting writer, having the happy faculty of taking all the kinks and 'isms out of a technical subject and putting it into plain English.

Fresh from hard railroad work, up to date, a student and a painstaker, Mr. Reynolds will be a great help to LOCOMOTIVE ENGINEERING. He will make the Car Department full and complete—something quite impossible while so far away.

LOCOMOTIVE ENGINEERING for 1896 will have 600 pages of reading matter, and this extra help will not come amiss to ye editors, while the readers will get the benefit of consultation with the best men in their respective lines. Mr. Reynolds will supervise the Question and Answer column of the paper.

Why Mile-a-Minute Trains Are Not Run.

A few years ago there was a protracted discussion in the railroad and engineering papers concerning the type of engine that would be necessary to pull trains from New York to Chicago in eighteen hours. Some writers contended that a new style of locomotive, better adapted than those used for high speed, would be necessary, and a variety of curious designs were proposed. We held that first-class engines of ordinary design would be found equal to the speed required to take a train 950 miles in eighteen hours. The correctness of our views has been proven by the high speeds maintained by ordinary locomotives in the racing between London and Aberdeen, and also in the fast run over the New York Central from New York to Buffalo. Instead of eighteen hours, which was considered about the possible maximum speed ten years ago, the train on the New York Central covered the distance between New York and Buffalo at a velocity which would have taken the train to Chicago in 15½ hours.

Hitherto there has been considerable conflict of opinion among railroad men as to whether or not a train run at a speed of about sixty miles an hour could be made to pay unless the passengers were charged unusually high rates. The run on the New York Central decided this, for it was demonstrated that a train of four coaches, capable of accommodating 218 passengers, can be pulled at a speed which would cover the distance between New York and Chicago in sixteen hours. If the traveling public were prepared to patronize such a train, it would soon be put on. There are no mechanical difficulties in the way of starting it out next week. The only difficulty is that there are not enough passengers traveling daily between New York and Chicago to fill a train of that size. Through travel between great cities is much smaller than it is generally supposed to be. Mr. George H. Daniels, general passenger agent of the New York Central, made the statement to the writer that the average through travel between New York and Chicago on all lines does not exceed 150 daily.

There is no better authority on a question of that character. With six companies competing for that business, there does not appear to be enough for each to

justify the running of fast through trains. In fact, none of the trains would pay were it not for the local business.

We find that a good many railroad companies are moving in the direction of better covering for the boilers of locomotives. In several shops that we visited lately we found them applying magnesia sectional covering, which is reported to give very satisfactory results if properly put on. The men in charge of the mechanical department of railroads generally are appreciating the heat losses that result from the use of the common wooden lagging. The plastic mixture of asbestos and lime, which was for a time used in place of wood, is now thoroughly unpopular. The most common objection raised against it is that it corrodes the jacket very rapidly. If it corrodes the jacket, it is liable to perform the more serious action of corroding the boiler sheets. Another serious objection to that material is that it conducts heat worse than wooden lagging. The Pennsylvania Railroad people used plastic covering, but they have now abandoned it and are applying magnesia wool in sections.

Almost every brick roundhouse ten years of age bears evidence of engines striking its back walls. New brick and mortar can be seen in the blackened original walls. When a hole is punched in a back wall, serious damage is often done the structure. There is always a delay to get material and the masons, and in cold weather the exposure makes the house very uncomfortable. What is the matter with making an arched doorway front and back? The back arch can be filled with stationary wooden doors, carrying the windows; the recess in the wall will give more room for the storage of heavy tools, jacks, etc., and when the hostler lets a rambunctious locomotive back into the rear, no other damage will be done than to knock down a wooden door that the shop carpenter can repair or replace in half a day.

We recently mentioned that the Pennsylvania Railroad Company are building in their shops at Juniata three compound locomotives of different types, in order to find out by the searching test of service what form is most economical for freight service. During a recent visit to these shops, we learned that a fourth compound, with the Goldsdorf starting device, is also under construction, and also a simple engine of the same general design as the compounds. The work is well advanced and the engines will soon be ready for service. The intention is to put them all to work pulling fast freight trains. The merits of the various types will be determined by their performance in hauling trains. The engines are heavy moguls. There is one peculiarity about the valve gear, the rocker shaft being set in a vertical position. This is done because the large wheels left too little room for the ordinary horizontal rocker. The arrangement is a peculiar one, and it will be interesting to watch how it works.

We notice in several specifications for locomotive boilers that some of our master mechanics are breaking away from the time-honored practice of making the firebox sheets $\frac{5}{16}$-inch thick. Experience with scale-forming water seems to prove that the thinner the firebox sheets are the better likelihood is there of absence of cracking. Where feed water is free from solid impurities, sheets thicker than $\frac{5}{16}$-inch may prove economical, but we think those having scale-forming water should be very careful about thickening sheets. If the steam pressure is considered too great for thin sheets, it would be the more judicious plan to put the stay-bolts closer together. When steel first began to come into use for fireboxes, $\frac{3}{8}$-inch was a common thickness, but it did not prove so durable as sheets $\frac{1}{16}$-inch thinner. If men who are returning to the thicker sheet are doing so experimentally, we should advise them to find out what their older compeers know about what thickness has proven to be the most economical.

A somewhat novel form of smoke-preventing device for furnaces and fireboxes has recently been patented, and efforts are being made to put it upon the market. It consists of steam jets in the grate bars, which blow upon the incandescent fire. The claim is made that the gases forming the steam are disassociated, and the combustion of the hydrogen and oxygen forming the steam yields a gain of heat. That is a fallacy that has often been exploded. There is the same amount of heat energy expended in tearing the gases apart as there is heat generated by the perfect combustion of the separate gases. As combustion is never perfect in furnaces, there is always loss of heat sustained by blowing steam into a furnace. Incidentally there may be gain, as when the steam is employed to create a current of air, as in the Clark smoke consumer. Whatever gain or advantage is given by the latest smoke-preventer, must come from the steam acting as an air conductor.

Much more attention has been paid in the past two years to making locomotives comfortable and handy for the crews than formerly. It is a lasting and paying investment to take a little time and pains to get the engineer's valve in the right place, the sand lever away from hot steam pipes, and cylinder-cock levers where a man can use them without looking. Injectors are now usually placed ahead of the cab, but be sure to bring the operating handles where a man can reach them without getting off the seat.

EQUIPMENT NOTES.

The Plant System are reported to be in the market for twenty-five refrigerator cars.

The Madison Car Company are building a large lot of cars for the Missouri, Kansas & Texas.

The Union Pacific are said to have less than two per cent. of their rolling stock in bad order.

The Chicago & Grand Trunk have placed a contract with Pullman to build 500 freight cars.

The Mobile & Birmingham Railroad are building a new machine shop for general repairs at Mobile.

The Omaha & St. Louis Railroad are trying to form a car trust to equip the road with 550 freight cars.

The New York, Ontario & Western have ordered one new locomotive from the Cooke Locomotive Works.

The Union Pacific have contracted with the Ensign Car & Manufacturing Co. for forty new grain and fruit cars.

The Pennsylvania Railroad have recently contracted for the building of 500 coal cars of 80,000 pounds' capacity.

The Pittsburgh, Chenango & Lake Erie have given a contract to the Ohio Falls Car Co. to build 500 freight cars.

The Wheeling & Lake Erie have put a large force of men to work repairing the rolling stock that has run down during the depression of business.

The Grand Trunk Railway have built their first compound locomotive in their shops at Montreal. It is a heavy engine intended for freight service.

The Union Tank Line are preparing to order 1,500 oil-tank cars of a very large size. They will be equipped with air brakes and M. C. B. couplers.

The Canadian Pacific Railway people are building 100 new box cars in their shops at Perth, Ont. They are said to be in the market with a large order of cars.

Barney & Smith people have received contract for 1,000 gondola cars for Washington Coal & Coke Co. The cars are built after same specifications as Pittsburgh & Lake Erie.

There is going to be an active demand among railroads for driver brakes for old freight engines. The Louisville & Nashville have recently placed large orders for these brakes, and several other companies are moving in the same direction.

The new management of the Southern Railway are already noted for the fair and generous policy adopted towards the employés. The latest manifestation of this is an announcement that employés will be granted passes to Atlanta for themselves and those dependent upon them, in order that they may see the Exposition.

PERSONAL.

Mr. C. H. Houghton has been appointed general manager for the receiver of the Stuttgart & Arkansas River Railroad.

Mr. J. S. Crews has been appointed general manager of the Albany, Florida & Northern, with headquarters at Albany, Ga.

Mr. C. H. Roser, of Lima, O., has been appointed superintendent of the Ohio Southern, with headquarters at Springfield, O.

Mr. W. B. Page has been appointed assistant engineer of motive power of the Philadelphia & Erie division of the Pennsylvania Railroad.

Mr. J. F. Sheahan, who was formerly on the Orange Belt Railroad, has been appointed general foreman of the Plant system, Palatka, Fla.

Mr. George F. Braddock has been appointed road foreman of engines of the western division of the Wabash, with headquarters at Moberly, Mo.

Mr. Frank Horton, heretofore chief dispatcher, has been appointed trainmaster of the Des Moines Northern & Western, with headquarters at Des Moines, Ia.

Mr. Thomas B. Russum has been appointed assistant superintendent and master mechanic of the New Jersey & New York Railroad, with headquarters at Hillsdale, N. J.

Mr. George A. Gallagher has been appointed general foreman of the Lake Superior Terminal & Transfer Railway, in charge of the motive power and car departments.

Mr. William H. Stevenson, of New York, formerly vice-president and general manager of the Housatonic Railroad, has been chosen president of the Lancaster & Hamden of Ohio.

Mr. E. La Lime, master mechanic of the Northern New York, at Santa Clara, N. Y., has been appointed superintendent. He will continue to perform the duties of master mechanic.

Captain Grant, formerly master mechanic of the Orange Belt Railroad, has been visiting Scotland, his native land, this summer, and is now returned. He is open for an engagement.

Mr. J. H. Noble, superintendent of the Yuma and Tucson divisions of the Southern Pacific, has been appointed superintendent of the Shasta division of that road, with headquarters at Dunsmuir, Cal.

Mr. E. E. Anderson, private secretary to Superintendent McBee of the Seaboard Air Line at Atlanta, Ga., has been appointed trainmaster of the third division of that road, with headquarters at Atlanta, Ga.

Mr. W. Cockfield has resigned as master mechanic of the Mexican Central at Chihuahua, Mex., to accept the position of locomotive and car superintendent of the Interoceanic Railroad, with headquarters at Puebla, Mex.

Mr. Josiah F. Hill, who has been assistant to Third Vice-President Baldwin of the Southern Railway, was on August 22d chosen secretary of that company. Headquarters, New York City.

Mr. H. O. Dunkle, trainmaster of the Akron division of the Baltimore & Ohio, has been appointed division superintendent of the Pittsburgh & Western, with headquarters at Pittsburgh, Pa.

Mr. F. B. Hubbell, of Texarkana, Tex., formerly third vice-president and traffic manager of the Texarkana & Fort Smith, has been chosen president of the Pan-American Railway Company.

Mr. Epes Randolph, formerly general superintendent of the Chesapeake, Ohio & Southwestern, has been appointed superintendent of the Yuma and Tucson divisions of the Southern Pacific, with headquarters at Tucson, Ariz.

Col. H. S. Haines has resigned as vice-president of the Plant system, with which he has been connected for many years, and it is understood that he is to be commissioner of the Southern States Freight Association when its organization is perfected.

Mr. B. C. Millner, Jr., formerly chief engineer of the Georgia Southern & Florida, and for over a year past, assistant to the chief of construction of the Atlanta Exposition, has been appointed assistant to the chief engineer of the Southern Railway, with headquarters at Birmingham, Ala.

Mr. O. H. Jackson has been appointed master mechanic of the Santa Fé, Prescott & Phœnix, with headquarters at Prescott, Ariz. He was formerly master mechanic on the Indiana, Bloomington & Western, and was for a time master mechanic in charge of the Big Four shops at Brightwood, Ind.

Mr. J. M. Turner has been appointed superintendent of motive power and transportation of the New Orleans & Western, with headquarters at New Orleans, La. He has been trainmaster on the Seaboard Air Line for the la-t few months, and before that was a division superintendent of the Illinois Central.

Mr. Edward L. Coster, of New York, who was elected an associate member of the Master Mechanics' Association at last convention, has been appointed by President Gilman of Johns Hopkins University, Baltimore, one of the aids to the jurors in the locomotive department of the Atlanta Exposition.

Mr. William B. Curtis, who has been connected with the traffic department of the Southern Pacific at San Francisco since 1886, and who has been in charge of the tariff and statistical bureau of the department for several years past, has been chosen traffic manager of the Traffic Association of California, with headquarters at San Francisco, Cal.

Mr. L. B. Sherman, for many years connected with the *Railway Review*, has accepted the position of Western manager for the *Official Railway Equipment Guide*, with headquarters at Rookery, Chicago. This pocket official list is gaining popularity very rapidly, the practice of revising it quarterly being appreciated by those who have to use the reference.

General Superintendent Sullivan, of the Illinois Central and Yazoo & Mississippi Valley, announces the following appointments: Mr. W. S. King, superintendent of the Mississippi division of the Illinois Central, in place of Mr. N. D. Wiggins, resigned; Mr. A. J. Grief, superintendent of the New Orleans division of the Yazoo & Mississippi Valley, in place of Mr. W. S. King, transferred.

A circular issued by Mr. Henry Bartlett, superintendent of motive power, and Mr. J. T. Chamberlain, master car builder of the Boston & Maine, says: "Mr. C. H. Wiggin is appointed master mechanic of the White Mountains and Concord divisions and Southern division, south to Manchester, including branches, in charge of all matters pertaining to the motive power department, with headquarters at Concord. The jurisdiction of Mr. E. T. Sumner, master mechanic of the Southern division, is hereby extended to include all motive power matters on Southern division and branches south of Manchester. Mr. J. T. Gordon is appointed general foreman car department, having charge of that department on Concord and White Mountain divisions, and Southern division south of Concord to Manchester, including branches exclusive of Portsmouth yard. Mr. S. R. Arey, general foreman car department at Salem, will have charge of all matters pertaining to car department at Portsmouth yard. Mr. G. F. Adams, general foreman car department at Nashua, will have charge of all matters pertaining to car department south of Manchester yard to Nashua."

Mr. John Soutar, the engine driver who ran the engine in the concluding run of the West Coast route, has been greatly lionized for the courage and skill displayed in running 90 miles in 80 minutes over the worst division of the road. The Scotch, as a people, are not celebrated for being emotional, but when Soutar arrived at Aberdeen a crowd of admirers took him from the engine and carried him shoulder high to the offices. Mr. Soutar is 61 years old, and has worked for the company for 45 years. He is a second cousin of Mr. A. A. Mayer, of the Grand Trunk Railway, at Stratford, Ont. When the writer was a youth, working in the shops of the road where the finish of the run was made, John Soutar was running a freight engine, and had the reputation of being the best driver on the road. A contest took place in those days in which Soutar took a leading part. The company received two unusually heavy freight engines, built at Leeds, and they were to be employed on

the through fast "goods" trains, and were expected to do great service. Soutar was appointed to one of them because the men who had previously run the engines could not get them to steam. A big wild-boasting fellow was sent from headquarters to run the other engine, and he told very loudly that he would show Soutar how to run an engine. They had a short struggle for superiority and Soutar easily came off victor.

In the death of Daniel Coxe, superintendent of the D., S. & S. road, one of the brightest young minds in the railroad field disappears. Daniel Coxe was about 29 years of age, and a son of Alexander Coxe, of the firm of Coxe Brothers & Co., the great coal operators. At an early age young Coxe took to building little locomotives, and his father finally fitted up a small but complete shop in his door-yard. Here young Coxe, with one mechanic—J. A. Beltz, now M. M. of the D., S. & S. road—built three locomotives exactly one-sixth standard size, including every detail, injectors, air brakes, etc. For these he built a track about a mile long; these little engines would do wonderful work and excited great interest. Soon after young Coxe became of age the firm of Coxe Brothers & Co. commenced the building of the D., S. & S. road, the main line of which is sixty odd miles long and all on their own land; young Coxe was made superintendent of motive power, and designed some freight engines that left many old "standards" in the rear. About two years ago he was made general superintendent of the road. He was married about a year ago. On September 6th he was experimenting with one of his little engines, when she struck an obstruction and turned over. Coxe was not hurt apparently, and sat on the track, giving instructions to the men picking her up, for some time, when he suddenly complained of a pain in the side, and only lived a few hours after. It is supposed that internal injuries, together with heart disease, hastened his demise. Daniel Coxe was a grandson of Richard Norris, the once famous locomotive builder.

Car Heaters.

A very handsome illustrated catalogue has recently been published by Mr. William C. Baker, of 143 Liberty street, New York. Mr. Baker has been in the car-heating business for thirty years, and he has been learning new facts about car-heating all the time which have guided him in making the various improvements effected on his car heater. He considers that his latest invention—the jointless, flexible and absolutely fireproof heater, which cannot be broken in a wreck—is the *ne plus ultra* of all means attempted for keeping cars warm. Besides giving excellent illustrations of the various heaters and their parts, the catalogue contains useful information about the transmission of heat, the circulation of hot water in pipes, and on a variety of other subjects relating to car-heating. The catalogue will be a highly useful handbook for master car builders and the foremen who have to apply the Baker heater to cars.

The C. W. Hunt Co., New York, have published an illustrated catalogue, showing the appliances made by the company for "Coal Handling for Steam Generation." There is good descriptive reading matter in the pamphlet, but the whole story is told by means of good engravings, mostly half-tone reproductions of photographs. A variety of coaling stations for locomotives is shown. Railroad men contemplating improvements on their coaling stations would do well to send for this pamphlet.

A work of high art is a pamphlet termed "Boring and Turning Mills," lately published by the Bullard Machine Tool Co., Bridgeport, Conn. It contains some of the finest engravings we have ever examined. These show the outside of the factory, the interior of the erecting shop, and eleven of the well-known tools made by the company. The only fault that could be found with the pamphlet is, that it does not conform to any of the Master Mechanics' Association standard sizes for pamphlets.

Railroad men interested in reducing the cost of castings, ought to examine the Tabor molding machine in use in the West Shore Railroad shops at Frankfort, N. Y. The machine was purchased in the expectation that it would mold the brake shoes used on the road, and it would have given great satisfaction if it had done merely that. But, in addition to molding all the brake shoes, it has done all the journal bearings, axle-box wedges and a variety of other small work.

The Tabor Mfg. Co., of New York, building automatic foundry molding machines, has recently been reorganized with the following officers: Harris Tabor, president; Angus Sinclair, vice-president; E. H. Mumford, secretary and treasurer. New life has been given to the introduction of power molding machines for foundry work, in which foundrymen are showing great interest, and the company feels sure of greater success for itself and for its machine than ever before.

The Standard Paint Co., New York, have just issued a sample book and catalogue which contains most valuable information for railroad men. It contains a full line of samples of car-roofing and roofing for general purposes, as well as insulating, sheathing and building papers. The pamphlet will be sent to men interested in these matters, on application.

"A Guide to Systematic Reading in the Encyclopedia Britannica" is the title of a book by James Baldwin, Ph.D., published by Werner & Co., New York. It will be found very useful to those who have the great work it relates to. The Guide tells in a comprehensive way what is to be found in the Encyclopedia Britannica, and where it is to be found.

The Hunt Air-Brake Co. Instruction Book has been issued for the benefit of the men handling the brake which is used exclusively on street cars. The information is given in a very simple fashion, and good illustrations are used to make the text easily understood. The headquarters of the company are in Pittsburgh, Pa.

The Morton mat and foot scraper, manufactured by Mr. John M. Morton, Cedar Rapids, Ia., is coming into use for car service. Those who have given the thing a trial say that it is a valuable aid to keeping cars clean.

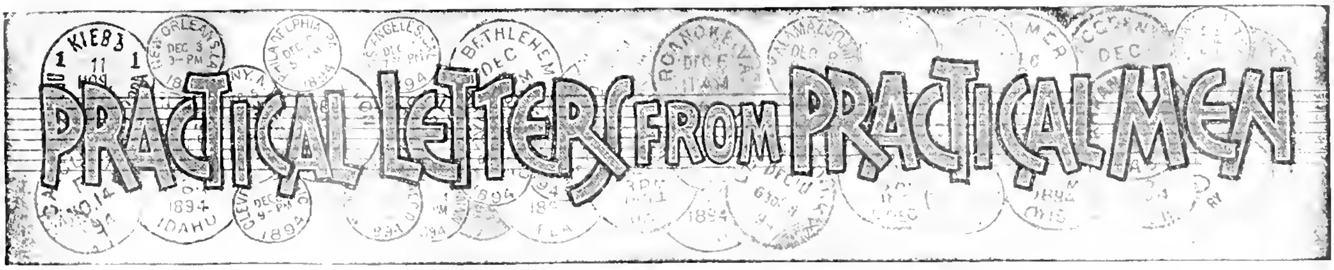
The Pennsylvania Railroad Company are building fifteen cars a day in their shops at Altoona.

Death Knell of the Locomotive Not Sounded.

In these days, when there are so many wild statements made by electricians about the possibilities of operating surface railroads economically by electricity, it is refreshing to find an electrical engineer whose views are worthy of attention, expressing himself on the subject. Such a man is Mr. Frank J. Sprague. He writes to the *Engineering Magazine*:

"The electric railway will operate almost all street railway systems and elevated and underground roads; it will replace the locomotive on many suburban and branch lines; it will prove a valuable auxiliary to trunk systems; but it has not sounded the death knell of the locomotive any more than the dynamo has sounded that of the stationary steam engine. Each has its own legitimate field, which will play its proper part in the needs of all civilization.

"The trolley car as an individual unit reaches a wonderful degree of efficiency; but the moment that the electric locomotive shall be used after the manner of a steam locomotive, and be placed ahead of a number of cars, the aggregate weight of which shall be from five to twenty-five times its own, the enormous loss of energy and the variation of pressure on a line would make the cost, with any possible allowable loss, entirely impracticable. The thirty, forty, or fifty-car train, pulled by a single locomotive with a limited train crew," he asserts, "presents an economical transportation of freight which no system of units on long-distance transportation can hope to equal."



Quick Steam-Raising.

Editors:

July 20th, Engine No. 10, 17 x 24, Baldwin eight-wheel passenger engine, was ordered out of here on a special. I had the boiler filled with hot water through a Rue injector (boiler washer). When boiler was filled, fire was put in firebox at 5:10 P. M., and at 5:35 P. M. engine had forty pounds of steam and was backed on the turn-table. There was nothing used but pine wood and oil waste to get steam up on this engine. I would like to hear from someone using fire kindlers, to see if they get up steam any faster than this. Engine No. 10 has a 54-inch boiler; firebox 34 inches wide by 59 inches long; 234 tubes 127 inches long.

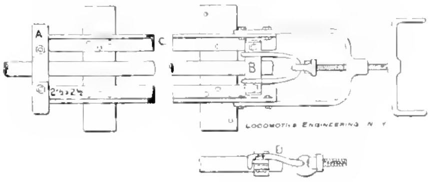
JAS. F. BLACKWOOD,
Gen. Foreman, S. C. & Ga. R.R.
Charleston, S. C.

Stretches Boiler Tubes Instead of Safe-Ending Them.

Editors:

Enjoying Mr. Jim Skeevers' "limited object lesson" in your August number made me regret the more my having missed the visit of Mr. Hill on his European trip, as I would have shown him the way in which Mr. Skeevers might have done away with safe-ending his flues altogether.

In our shop here never an iron flue has been welded since they used iron flues, a matter of eighteen years, so that no trouble



ever arose from welded joints in consequence.

The flues are cleaned and heated evenly a bright red heat, on a common smithy, the fire being spread conveniently a length of about 28 inches; the spanners *A* and *B* being fixed on the outer ends, suiting the length of the angle-iron concern, marked *C* in the sketch.

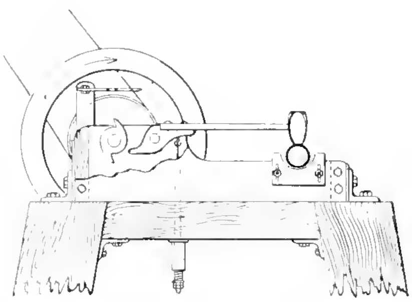
The hook *D* being then put over the spanner *B*, as many turns are given by two men, to the screw as required to stretch the flue to a suitable length, this never taking more than a single heat.

If flues have been cut out carefully, $2\frac{1}{2}$ inches will do, but more stretch can be given.

A few taps with a mallet take away any slight crookedness.

The operation is afterwards repeated twice, near both ends and in the middle part lastly, so the flues just outlive their four inspection turns as the engine is overhauled.

We find the thickness of the tubes coming down from 2.9 millimeters to about 2.6 millimeters only, by the operation, so there need be no "thinking" about the matter of collapsing, as the diameter lessens down



from $1\frac{13}{16}$-inch to $1\frac{11}{16}$-inch, and a gain of stiffness might be calculated.

The narrowing of the flues does not interfere with the cleaning in the sheds.

The cleaning of old coated flues is done here by passing them under a set of four lightly vibrating hammers worked by cams, the flues resting in bearings just free from the grooved heads when still; the scale is knocked off sharply by the elastic "rat" when in motion, eight times every revolution of the shaft. The little sketch may give an idea of the concern.

Since this hammering (the invention of our Mr. Oberstadt) came into use our neighbors had to do without the fine drumming of our revolving cleaners, but we don't care to ask them how they like the substitute, as our flues are now no more damaged and crystallized as by our former way of cleaning.

TH. A. BERTRAND,
Manager.
Dutch State Ry. Shops, Utrecht, Holland.

Bracing Flue-Sheets.

Editors:

I have read considerable about staying flue-sheets. I think that I have a very good way. I have never seen it used anywhere else, so describe it:

We used to put a bolt through the flues; it would stay tight a while, and then the flue would get to leaking. The bolt would have to be removed to get at the flue, and it is a pretty hot job with steam on the engine.

When I put in a new flue-sheet I leave out four to six flue-holes in places where the sheet is liable to bulge, and drill a 1-inch hole instead. When the flue-sheet is riveted in place I stretch a line (so as to tap straight) from front flue-sheet to back flue-sheet and tap with a $1\frac{1}{8}$-inch, 12-thread, stay-bolt tap. Then I make a bolt with one end threaded to fit flue-sheet hole and the other end enlarged to slip into flue. This is welded to flue, the solid end screwed into the flue-sheet and headed down, same as a stay-bolt; roll and bead the front end, and you have a brace that will not leak or break.

T. A. JAMESON,
Southern Ry. Co.
Knoxville, Tenn.

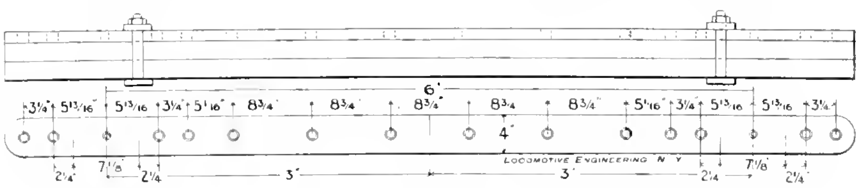
Templates for Drilling Engine-Truck Frames and Pedestals.

Editors:

In connection with your general illustrations of various jigs or templates for correctly, systematically and economically doing work on the various parts of locomotives, I wish to call your attention to our method, or templates, for drilling truck bars or frames, and its pedestals or truck jaws. We have for the truck bars a template correctly drilled, and with holes bushed with steel, as shown in sketch.

By clamping template, as a guide for drill, on two truck bars, it insures the work being done accurately, all alike and uniform in size of holes.

The pedestal chuck we use for drilling the pedestals to go on these truck bars,



STEEL-BUSHED TEMPLATE, FOR DRILLING TRUCK FRAMES.

which insures their all being drilled alike and positively the same distance from their face. It is impossible for them to be drilled wrong; also, the holes are sure to be fair with the holes in truck bars.

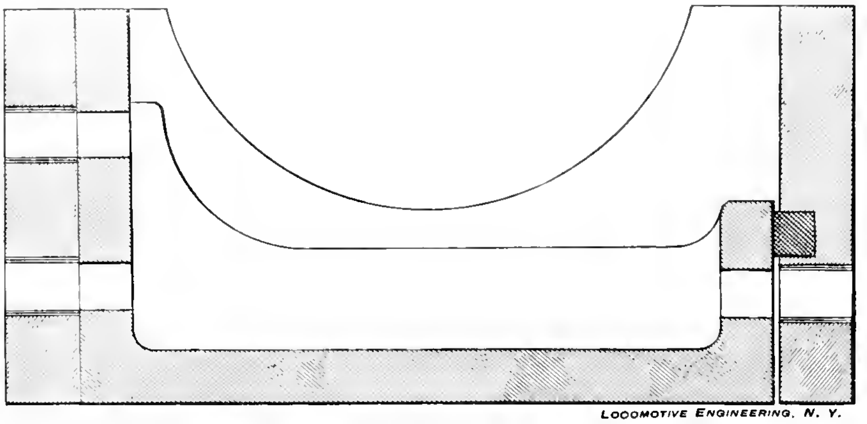
The operation is to lay the chuck on drilling machine table; next place the pedestal therein, the face of which will also go down to the table; then drive the key (shown at right of engraving) to hold it there; turn the chuck on end and do the drilling.

The inside of this chuck is slotted true and square with its ends. The pedestals are only slotted or planed on the ends.

When bolting pedestals to frame, there is no need of measuring to see if jaws are proper distance apart for the truckbox, or of tramming. The holes coming fair with each other need very little reaming, all holes requiring the same amount.

The result is that bars can be drilled on one machine, the jaws at the same time being drilled on another machine, and the bolts being turned at the same time at the lathe to suit the given reamer to be used, enabling the work to be done accurately, with despatch and comfort to those doing it.

THOMAS FIELDEN,
General Foreman,
St. Louis, Mo. Mo. Pacific Shops.



CHUCK AND JAW. KEY SHOWN TO RIGHT ABOVE DRILL HOLE.

Badly Balanced Crossheads.

One of the most common failures of locomotives to-day comes from the breakage of piston rods, and this species of failure is particularly common with the Laird guide. In talking on this subject Mr. Reuben Wells, superintendent of the Rogers Locomotive Works, made some points which are well worthy of consideration. He said: "It seems to me that the breakage of piston rods is mainly due to the crossheads being out of balance, you may say. Several years ago, in looking up the matter, as to what was the cause of the breaking of the piston rods, particularly where the Laird crosshead was used, I took a crosshead of about the ordinary size, such as is used for a 10-inch cylinder, and I found that the center of gravity of that crosshead was $4\frac{3}{4}$ inches above the center line of the piston rod, and it weighed probably 300 or 325 pounds. In looking a little farther into the breakages that were reported, I found that they occurred mainly on engines with that kind of crosshead, and where the speed of the engine was what you might consider excessive. The engines had wheels not more than $4\frac{1}{2}$ feet in diameter, and were frequently run at speeds of 50 miles per hour; and the effect of the center of gravity being so far above the center line of the piston would necessarily cause the rod to break in the course of time. It had the same effect as a driving wheel would have if it is over or under-balanced and run at a high speed.

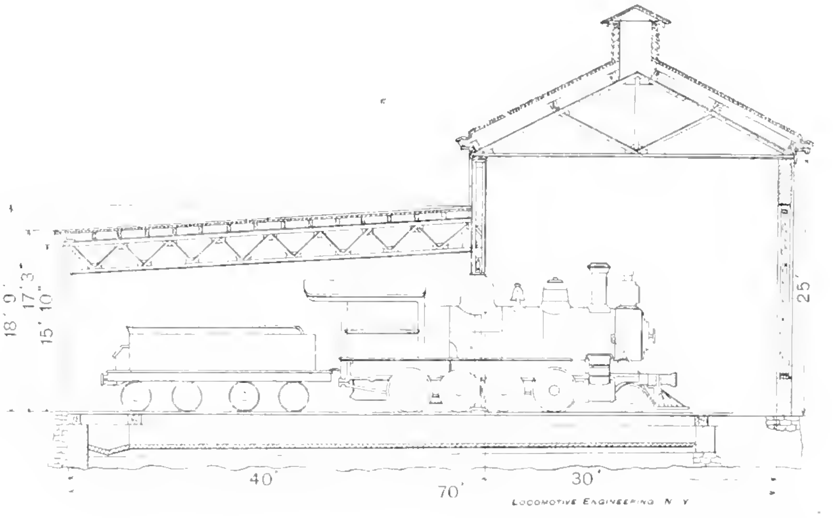
"Now, I know that the Laird crosshead has been used for many years with very good success, and given but very little trouble from breakages, but it was where the engines were run at a moderate speed, probably not more than 20 or 25 miles an hour. But the breakages that I refer to mainly occurred with that kind of crosshead, in engines that were running at an unusually high speed for that size driver, and I will say also that the crossheads used with four-bar guides are often made with the wings so high above the center that their center of gravity is probably 3 inches above the center of the piston line, and where breakage occurs in them it is probably due to crossheads of that kind. The center of gravity of the crosshead is too far above the center line of the piston rod, and at the end of each stroke the tendency is for the crossheads to continue on, and at the other end of the stroke it is reversed.

"Now, in the case of what is called the two-bar guide—that is, one bar above and one below the piston—I have never known of any trouble from broken piston rods, because the crossheads of that kind are balanced. But in the Laird crosshead they are very much out of balance in the case I mention, and I think that other crossheads of that kind are about in that proportion, some are not quite so much; but they easily run from 4 to $4\frac{1}{2}$, and sometimes as high as $4\frac{3}{4}$ inches center of gravity above the center line of the piston rod."

Norfolk & Western Engine House.

The annexed engraving shows a novel form of engine house designed by the mechanical department of the Norfolk & Western, and recently erected at one of their division points. The desire was to make a house that would dispense with smoke jacks and not have a very large volume of space to be heated. The engraving shows how successfully the purpose was accomplished.

Besides its novel shape the engine house has numerous other good features. It has a drainage tunnel all round, in which all pipes for steam, water and gas are set so that they can be easily reached. The pits are built so that a man working in them will have dry feet, and a flooring has been put down which will stand the weight of a jack and yet be water-tight.



You can get any books on air brakes you want without money by getting up a small club of subscribers for this paper. Write us about it.

The papers have been full of death notices of "the oldest locomotive engineer" lately; must have been lots of 'em.

AIR-BRAKE DEPARTMENT

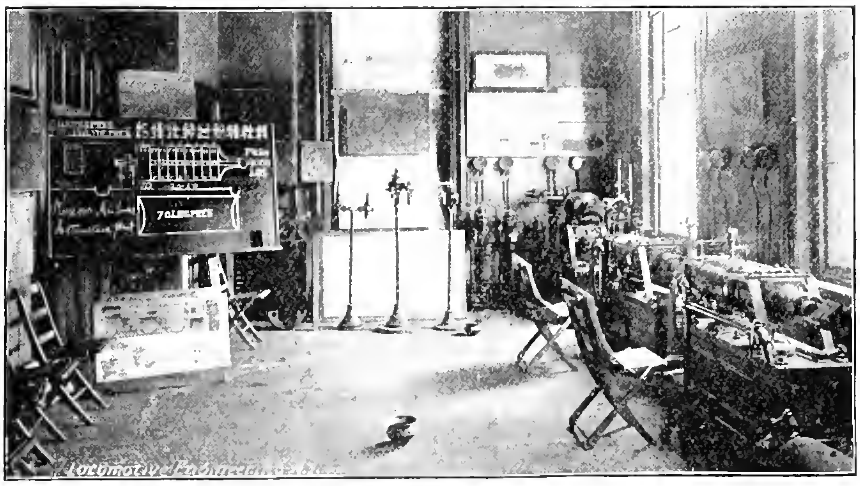
Conducted by F. M. NELLIS.

A Model Air-Brake Instruction Plant.

Following is an illustration and description of an air-brake schooling room recently installed in the shops of the Pennsylvania Company, at Renovo, Pa., which will doubtless prove interesting to all, and especially instructive to those of our readers who contemplate the erection of a similar plant at some future time.

J. W. Sheldon, traveling engineer and air-brake instructor of the P. & E. Division, conducts the classes, which assemble at regular intervals for instruction. Engineers, firemen, conductors and brakemen are notified by bulletin several days in advance of each meeting, and are asked to come prepared to discuss certain specified subjects. In this way all classes of men are kept in touch with the air brake, and all local annoyances are discussed and corrected. The officials of the division give it their hearty support, and already have been brought to appreciate its value as an educator.

Pump for supplying air is located in machine-shop boiler room, about one hundred and fifty (150) feet distant. Main reservoir and all pipes are placed under floor, in basement. The first, or top cylinder, represents a tender equipment, plain triple with one sectional, connected; second cylinder underneath is a 10 inch passenger equipment, and the third and fourth cylinders are freight-car equipments with a sectional quick-acting triple valve connected to the third car. Auxiliary reservoirs for brake valve, tender and passenger car are placed on floor back of the equipment. Air-signal equipment, reducing and diaphragm valves are situated in right-hand corner. Duplex gages to show pressure in main reservoir, train line, auxiliary reservoir and brake cylinders are placed on side of walls. Stirrups are fastened to all cylinders, with blocks to regulate travel of piston and to show the pressure at all points of travel from 4 to 12 inches.



AIR-BRAKE INSTRUCTION ROOM, P. R.R. SHOP, RENOVO, PA.

The room has a seating capacity for sixty (60) men.

A Good Samaritan's Stock Below Par.

To assist a fellowman in distress has been an inherent trait in the human family ever since time immemorial, and possibly is possessed by the average railroad man in a greater degree than any other individual in the daily walks of life. Many men have at some time or other been in a position where they would be glad to lend a helping hand by giving badly-needed advice, were they not fearful that such might not be well received.

A certain air-brake man, while recently traveling over a strange road, felt the brakes apply suddenly, and the train come to a standstill with a lurch. With characteristic curiosity he immediately proceeded to ascertain the cause of this unusual stop. He found the coupling between the tender and the baggage car had broken, and the engine had come to a standstill about a car-length from the train. The air was escaping from the hose on rear end of tender as rapidly as the pump, which was striking the heads at both ends of the stroke, could make it. Seeing the brake-valve handle was in full release position, the air-brake man stepped to the side of the engineer, who was in the act of bleeding off the tender brake, and with all the magnanimity he could muster, said:

"My friend, if you would lap your brake valve the main-reservoir pressure would be saved, and when you couple up again the train brakes will release more readily."

The advice was given with the kindliest intent, but the air-brake man was soon aware that he had made a mistake, for above the noise of the escaping steam at the pop valves, the engineer shrieked:

"Wuttellzat to you? You tend yer own bizness and I'll take care of mine."

The air-brake man registered a cast-iron vow that he would henceforth keep his information for his own line, where he was better known and appreciated.

Could But Wouldn't—A Problem for the "Nut-Crackers."

A good moral is contained in the following story as told by Mr. S. J. Kidder to a group of air-brake men one evening in the rotunda of the Lindell Hotel, St. Louis, during the convention of the Association of Railroad Air-Brake Men last April. He said:

"During the past few years much improvement has been made in air-brake mechanism, but it is of only comparatively recent date that special effort has been made to perfect the knowledge of the men handling them. Various methods have been suggested and practiced in an endeavor to teach engineers how to handle the brakes, but one of the most peculiar and effective ones that ever came under my observation I am about to relate.

"Several years ago, it was my fortune to be road foreman of engines on one of our large Western trunk lines, and among the engineers was Bill W., an old passenger man who rendered first-class service, generally speaking, but could not, or did not, rather, do satisfactory braking. I rode with him frequently, and upon calling his attention to his improper method of handling the brakes, his usual response was that he was doing the best he could. Finding that throwing sod did no good, I had Bill taken off the engine, giving him

a consolidation on freight, the engine being devoid of any brake fixtures.

"Bill soon found that there was quite a radical difference between getting over the road in ten to fifteen hours, instead of three or four, and the first time I met him, a week or more later, he asked to be reinstated on his old run, but I gave him no satisfaction. Several days went by, and he again asked for reinstatement, but, as in the former instance, his request was not granted. Another week elapsed, during which time Bill and his '324' had been putting in long and hard service toting box cars over the division. Chancing to meet him, he again wished to get back on his old run.

"Said he, 'I don't like this freight business, and if you will let me take my old engine I will do the braking all right.'

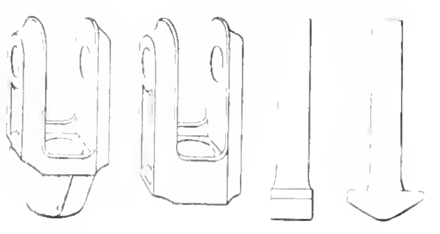
"I replied, 'Bill, I don't quite understand how you have learned the art of air-braking in three weeks on an engine without brakes, when you admitted that you could not handle them when having everyday experience. Your work was not satisfactory to the company, and, as a consequence, I was compelled to remove you, and put you where the appliances were of such a character that you could manipulate them.'

"Bill went away quite crestfallen, while I sauntered over to the office and arranged to have him put back in his former position when the change could conveniently be made. He was soon pulling 'varnished cars' again, and during the time thereafter that I was connected with the road, his brake-work was of a most model character.

"I don't venture to say why it was that Bill could not learn to handle brakes during his several visits to the instruction car, and with the numerous practical lessons I gave him on his engine on the road, or how he could acquire all this information in a limited time on an unbraked engine, but give the facts and leave it to the 'nut-crackers' to solve the problem."

Kelly's Brake Fork.

These forks are made of malleable iron, and weigh from $2\frac{1}{4}$ to $2\frac{1}{2}$ pounds each, and are from 3 to 5 pounds lighter than the wrought forks. The end of brake rod is upset with bolt machine, with long countersink under T head, as per sketch;



forks are then put on rod, and the other end upset, making the rod complete and ready for service without welding, while the wrought forks on rods, where two forks are required, take four welds to make rod ready for service.

These forks have been tested with 10,000 pounds without a fracture; there are some hundreds in service on the D., S. S. & A. They are manufactured by the Dayton Malleable Iron Co.

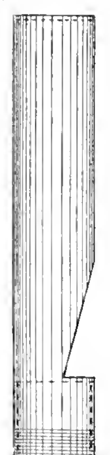
Mr. Geo. W. Kelly is foreman blacksmith of the D., S. S. & A. R.R., and served his time in the Altoona locomotive shop of the P. R.R.

A Pointer.

Problems for solution must be accompanied by the answer. The problem will be published in one number and the answer in the following one. Those having a solution for the problem must have it in by the 20th of the month, as LOCOMOTIVE ENGINEERING goes to press on that date, and answers received after that time cannot be published in that issue. Several answers to George B. Snow's "Queer Antics of a Tender Brake" have been received since September issue was mailed to our subscribers, and therefore cannot be given any credit. Be careful to give sufficient data.

A Simple Signal Whistle.

This little engraving will show how to make a cheap and effective whistle for air signal. It is made of a piece of pipe, notched much as we used to notch willow whistles in the old school days, a plug just under the notch restricting the passage and putting it in the right place.



Mr. Samuel W. Dodds, of Topeka, Kan., sends this, and says he has tried it and found it better than the bell whistle; it has no small opening to gum up, and the smallest passage is exposed where it can be cleared with a toothpick. It is very sensitive, blowing the same with 10 to 40 pounds. The tone can be changed by lengthening or shortening the bell, or top part of pipe.

LOCOMOTIVE ENGINEERING for 1896 will contain 600 pages of reading matter, and will be better in every way than it ever has been. If there is not a hustling club raiser on your road in your town, write us; got a story for you.

The Columbian Metallic Rod Packing Co. have been appointed selling agents for the Foster Engineering Company's pump governor and inside check. The work of introducing these specialties to railroad companies will be done by Mr. George P. Wilson, the popular general agent of the Columbian Metallic Rod Packing Co.

CORRESPONDENCE.

A Plea for Air-Brake Schooling Plants.

Editors:

Inasmuch that a very evident and commendable desire has for some time past been manifested by railway employés to become more proficient in their knowledge of the construction and operation of the air brake, it would seem proper for railway officials to encourage this interest in their men by furnishing and equipping air-brake schooling plants at principal terminal points, where further education may be had.

Such would certainly redound to the interest of the road, as better service is always had from intelligent work. It is also essential that a competent instructor be selected and given official authority in air-brake matters. Such a course would be decidedly healthful to the air-brake service, to say nothing of the elimination of frivolous excuses now frequently given (and sometimes accepted) for alleged air-brake failures, samples of which came under my notice recently, and which are as follows:

Stop was made. "Everything O. K." Next stop was a failure; brakes would not apply, and train was stopped with the reverse lever. The black pointer on air gage indicated 70 pounds, and upon examination the angle cock on rear end of the train was found to be wide open, and this was given as the cause for the brakes not applying. While aware that it is possible for the pump to stop (which it probably did) and allow the train pressure to reduce below effectiveness where stops are infrequent, my main object in citing this case is to show what very lame excuses are sometimes given to cover up some piece of carelessness.

Another case of running by and stopping with the reverse lever was attributed to a burst hose. A slight leak was found in the hose, but the cause of the brakes not stopping the train was the fact that the pump had stopped, and the air had leaked down below effectiveness, and hadn't sufficient force to stop the train. If enginemen who are afflicted with these mysterious (?) actions would get into the habit of watching the gage, and possessed the knowledge concerning the principles of the brake such as an instruction plant gives, these excuses would soon cease to be given. It is an admitted fact that where the brake is least understood, there the most complaints about brake failures (?) are had.

The instruction book is absolutely necessary, as it is the starting point, yet an instruction plant will do much to broaden the views of men such as nothing else can do. Theory without practice is almost useless; practice without theory is sadly deficient and lame; combined they make perfection.

S. D. HUTCHINS.

Columbus, O.

Automatic Release for Driver Brakes.

Editors:

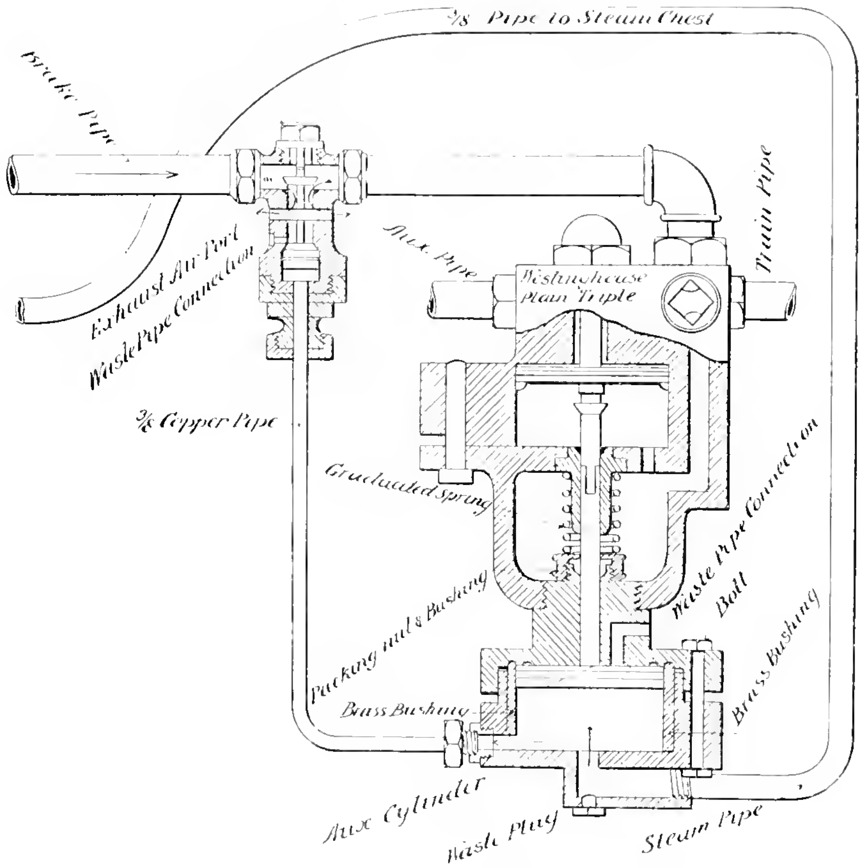
The following is an illustration and description of an automatic release for driver brakes which I have patented, and send you for publication in LOCOMOTIVE ENGINEERING, believing it may be of interest to your readers. The device has given quite satisfactory trial tests:

A ⅜-inch iron pipe, in which there is a small globe valve, leads from the steam chest of the locomotive and connects with an auxiliary cylinder attached to the bottom of the driver-brake triple valve. A ⅜-inch copper pipe leads from this auxiliary cylinder and connects with the trip in the brake-cylinder pipe, in which there are two check valves, seating opposite each other. When the engine is reversed, the back pressure thus accumulated comes through the iron pipe to the auxiliary cylinder on the bottom of the triple, strikes the piston working therein, and causes the stem to push upward against the graduating stem, throwing the triple valve to the release position. At the same time, the back pressure passes through the copper pipe to the triple valve, giving a greater pressure on the lower check valve, seats that valve and opens the upper one, which allows brake-cylinder pressure to exhaust freely and quickly.

As this device is controlled by back pressure in the steam chest, and the release takes place in two seconds, it is impossible to slide drivers while engine is reversed and brakes applied. Engineer can release driver brakes when descending long mountain grades, when drivers have a tendency to heat up. As it only has action upon engine brake at will of engineer, and does not affect the balance of the train, it will be seen that flat drivers and loose tires will be entirely dispensed with by using this device.

W. PELHAM.

Raton, N. M.



[We view this device with considerable askance, and gravely doubt that it would prove a success in continued practical service. The liability of steam leaking from the auxiliary-cylinder attachment into the triple valve is a serious objection to it, as it is well known how detrimental water is in a triple valve, especially in cold weather. Should leakage past the globe valve occur, as it frequently does, both pipes and auxiliary-cylinder attachment would be filled with condensation at steam-chest pressure, causing the upward pressure to be so great that it would be impossible to apply the driver brake. The upper check valve in the brake-cylinder pipe trip offers an additional opportunity for loss of brake power through leakage. When such devices are attached to the system, the responsibility for the air brake's proper performance is gone.

Our opinion is that the engine brakes should be worked continuously with the train brakes, as expressed in our August number; if there are any conditions existing which make it disadvantageous, they can be removed. We do not favor an independent driver brake, or any attachment which seeks to separate the engine brakes from regular and constant action with the train brakes, for reasons previously expressed. Practical experience on the Great Northern and Northern Pacific railroads has demonstrated that a properly designed 75 per cent. driver brake can be successfully and advantageously operated continuously with train brakes on grades 116 feet to the mile and 18 miles long. Under same conditions a similar performance should be had on the Raton and Glorieta mountains. To what steepness of grade the use of continuous driver brakes will be carried has not yet been determined, but there are substantial reasons for believing that, with proper consideration of associated conditions, it will soon be used in all ordinary mountain service, leaving only a few isolated exceptions, which, with the use of the truck brake, and pressure-retaining valve on tenders, may even include this extreme. The pressure-retaining valve on tenders has proven a very valuable assistance in holding trains on heavy grades where it is used, and there are a few experimental cases on one mountain road where it has been successfully carried to the surprising extent of use on driver brakes.

That the driver brake is not responsible for the wholesale loosening of tires attributed to it, is confirmed by the Air-Brake Men's Committee report, as published in their 1895 proceedings, wherein practical research proved that much of it was due to improperly fitted and thin tire, and poorly-designed independent straight air, steam or vacuum brakes, or because the engine was required to hold an undue amount of the train load. Loose tires were had before the advent of the driver brake, and will only be eliminated when driver brakes are properly designed, greater care is taken in fitting tire to the wheel and very thin tire is abandoned. Neither the above device nor any other can compensate for these shortcomings.

Our July number gives an extract from the Air-Brake Men's proceedings of a series of practical tests made on the N., C. & St. L. Ry., at Nashville, Tenn., to determine the relative holding power of the driver brakes and engine reversed, in which the brakes proved their superiority; also that there is no necessity for reversing the engine when the driver brakes are applied, and that to do so will surely lengthen the stopping distance.

In duly crediting the designer for the ingenuity required to invent a novelty, we cannot resist reminding inventors that all novelties are not necessarily improvements, and that unless the invention meets a want, or is an improvement on the present mode of doing things, it is, at the best, merely a passing novelty with which the inventor feels more or less satisfied, but embodies nothing greater than his futility of effort.—ED.]

The Air-Brake Defect-Card System.

A system whereby defective air brakes are reported and repaired has been in vogue on the Pacific railways for some time past, and is gradually moving Eastward. Some of the Chicago roads have had it in use for a number of years, possibly nearly as long as the Pacific and other Far Western lines. By the use of this system the conductor of either a freight or passenger train is required to locate the defect and make an intelligent report to the car repairer, who can then make the necessary repairs under protection of a blue flag without waiting to have the car switched on the shop tracks, where air pressure can be had. Frequently repairs are made while engines are being changed. After the repairs have been made the card is forwarded through the air-brake inspector to the superintendent of motive power.

The system is good throughout. In the first place the knowledge of the conductor and train crew must be such as to enable them to readily and properly locate a defect. The repairman can do his work while car is in train. He must then sign the card which thus certifies that he has done the work. Should he neglect or but partly do the work, another card for the same work will be turned in on the next division, and will show against him. A sample card is herewith shown, furnished us by M. E. McKee, general air-brake inspector of the Great Northern Railway, and is but little different from those used by other Western lines.

GREAT NORTHERN RAILWAY LINE.

Conductor's Air-Brake and Train-Signal Report.

Train No. Engine No. Division Date 189

Defects.	Car Initials.	Car Numbers.
Hose coupling leaks..		
Train pipe loose		
Leak in pipe joints where marked.		
Leak in triple valve...		
Angle cock leaks		
Angle cock handle broken		
Release valve defective		
Retaining valve defective.		
Conductor's valve defective		
Train-signal cord broken		
Train signal valve defective		
Brakes do not apply properly..		
Brake leaks off..		
Piston travel too short (less than 5 inches)		
Piston travel too long (more than 8 inches)..		
Brakes do not release properly		
Brake slid wheels		
Dummy coupling defective or missing.		
Brake cut out on account of defects.		
Other defects		

.... Conductor

INSTRUCTIONS. This report must be filled out by Conductor and handed to Car Foreman at terminals, who will send to Air-Brake Inspector, St Paul shops. Place numbers of cars having defects opposite the defect named. Use more than one blank if necessary. If any repairs have been made by trainmen report on back of this blank under heading "Repairs Made by Trainmen."

[REVERSE.]

Repairs Made by Trainmen.

Car Initial	Car Number	

Repairs Made by Car Repairers.

[Ten blank lines]

.... Inspector at

NOTE When repairs have been made by Car Repairers the Inspector will send this report to the Air-Brake Inspector, St Paul shops, stating hereon what repairs have been made, and such other facts as should be reported. This report will then be forwarded to the Superintendent of Motive Power, St Paul.

Operating officials who think that slack adjusters are a fad should take a few minutes off to figure out the difference in pressures, under cars of the same weight, with varying piston travel.

⁂

Air-brake instructors can do more good in five minutes by showing a car repairer how to clean a triple than by using an hour in telling him. An object lesson is the most lasting.

⁂

Rotary valves which need most frequent grinding are found on engines where the emergency application is "standard."

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(17) F. B. M., Lexington, Ky., writes:

I have an equalizing brake valve on my engine which acts queer. Every time I apply my air in service-application position, the black pointer drops down very swiftly, and I get quick action on my train. Please suggest to me how I can correct it. *A.*—The small equalizing reservoir is probably partly filled with water, or else the gasket in union which connects it to the brake valve is crushed into the opening, and almost cuts the small reservoir off.

(18) S. A. H., Cleveland, O., writes:

What is the small ¼-inch plug for which we find in the side of the new engineer's brake-valve? A friend of mine says it is to connect into for the air bell ringer or sand device. *A.*—He is wrong. All of those devices should receive their air from the main reservoir; never from the train line, as each time they are used the brakes will be applied in a greater or less degree. During the first days of the feed-valve attachment it was found necessary to temporarily remove it for further improvement, and the ordinary excess-pressure valve was substituted temporarily. As the pump governor controlled main-reservoir pressure, and the feed attachment controlled train-line pressure, it was necessary

in the absence of the feed attachment to temporarily change the pump governor from the main reservoir to the train line. Hence this plug. At present it is useless.

(19) H. L. B., Cincinnati, O., writes:

Some of our train crews complain that when they pull the whistle cord to signal the engineer, whistle in cab don't blow, and they blame the trouble on the engine. I think they are wrong, and have told them so. I never let an engine leave the roundhouse without I go to signal hose on rear end of tank, and, by letting out a little air, see that the whistle gives the proper blasts. I reason that if it blows all right with the engine alone, and does not with the cars, it is either the fault of the cars or the way the crew works it. Am I right? *A.*—Partly. Your roundhouse test is decidedly imperfect and very misleading. Any signal almost will blow by making a heavy discharge at the angle cock, but when coupled to train the exhaust at car discharge valve is many times smaller; hence your trouble. See that the engine equipment is in proper condition by using a testing device such as is shown on page 91 of the Air-Brake Men's 1895 Proceedings, and which you can easily make yourself. The greater part of the trouble is probably in the clogged condition of the strainers in the car discharge valves. One-second discharge and two seconds between pulls is a good rule for train crews to be guided by.

(20) J. L. S., East Grand Forks, Minn., asks:

1. In a train of air cars equipped with quick-action triples, what would be the effect on cars behind them if the air on one or more be cut out, in case an emergency application was to be made? *A.*—After a certain number of cars are cut out, it is impossible to get the quick-action application on cars behind them, for the reason that each car must take into its brake cylinder a part of the train-pipe pressure, thus making a reduction to actuate the emergency valves of the following triples. If cars are cut out they cannot do this; however, the reduction made by a quick-action application on a car reaches out through three or four cars with sufficient force to get a quick-action application, even though that number of cars be cut out. The M. C. B. rules require that the quick action shall jump through three cut-out cars. In event of cars behind those cut out not being able to apply quick action, they would apply as in a service stop. 2. What effect would a car equipped with a plain triple have under the same conditions? *A.*—It could apply with its own auxiliary-reservoir pressure, but would be a hindrance to quick action equal to a cut-out car.

(21) J. W. M., So. Frankfort, Mich., writes:

1. What causes the air to blow out of hole in top of governor; also out of exhaust 60, plate 2, Fig. 7, and not shut off pump when it should? 2. What action would the governor have if exhaust 60 is stopped up? *A.*—1. We presume your reference figures have been taken from the instruction book, where 60 should be changed to 10. The escape of air at port in spring-case 13 indicates a leakage past or through the diaphragm 19, caused by either a ruptured diaphragm, loose diaphragm nut, or spring-case loosely screwed into the body 12. Air blowing out through opening in 10 is caused by air leaking past piston 5. A bad blow at either one of these places will prevent the pump from shutting off, as the pressure which is intended to raise the diaphragm valve and force the piston downward is wasted through the openings. You will probably find that packing ring is either poorly fitted or is entirely missing. If this is true, it should be corrected; also, cylinder in which it works should be rebored, else when the other repairs are completed piston will descend and refuse to rise with a reasonable reduction. (See page 14, Air-Brake Men's 1895 Proceedings). 2. It would allow the pump to keep on running, as the pressure becomes equalized on both top and bottom sides of piston 5.

(22) C. M., Burnside, Ill., writes:

I would like a little information through LOCOMOTIVE ENGINEERING. I have an engine with a triple valve for driving brake; also one for tender, both old style. I make a reduction of 10 lbs. and set the brake; driving brake stays set, but tender brake releases just the same as though I had moved the brake-valve handle to full release position. Now the question is—Will a leak in pipe between triple and brake cylinder cause triple-valve piston to move so as to open release port? If so, why? As near as I can see, when brake valve is lapped the communication between the auxiliary reservoir and brake cylinder is closed, and remains so until the pressure either on the auxiliary side or train-line side of triple piston is changed. I cannot see why the pressure taken out of brake cylinder would recharge the train line or bleed the auxiliary, one of which must be done to cause triple piston to move slide valve to release position. A friend of mine says this leak will cause it, everything else being tight. *A.*—You are right in your belief that, to move the triple valve to release position, there must be either an increase in train-pipe pressure or decrease in auxiliary-reservoir pressure. A leak in brake-cylinder pipe, or in the cylinder proper, will not, in itself, cause triple to move to release position, but, of course, cylinder pressure will escape and brake be lost. To ascertain the cause of your tender brake releasing, first test rotary valve by cutting out both tender and driver brakes, leaving bleeder cocks wide open. Lap the brake valve and pump up 90 or 100 pounds in main reservoir. Open angle cock on rear end of tender, and immerse hose coupling in a pail of water for a couple of minutes. If bubbles form and rise to the surface there is leakage past the rotary valve. Possibly your driver-brake piston travel is so short that brake is applied full with 10 pounds or less, which is possible when in combination with an over-large auxiliary reservoir; this, with a long travel on the tender, would cause the release you mention. For experiment to prove this, lengthen out your driver-brake piston travel, and shorten the tender travel, and the driver brake will probably release and tender brake remain on. Also look for leaks in the tender auxiliary reservoir and connections, and make sure that the slide valve, its seat, and graduating valve are not leaking. Packing ring in piston of driver-brake triple may be broken, allowing a certain amount of pressure to return from auxiliary reservoir to train pipe. Have rotary valve properly reseated if found to be leaking. Before you make any change in your brakes as they perform at present, allow the brake valve to remain on lap for several minutes after the tender brake has released, and see if the driver brake does not also whistle off.

Stop pouring water in the driver-brake cylinder to swell out the leather and make it tight, for it only lasts until the moisture dries out. A regular cleaning and occasional oiling is the only way to keep tight packing and preserve the life of the leather.

Train crews should not imagine that the harder they pull, and the longer they hold on to the signal cord, the better signal they will give the engineer, for it is to the contrary. There is no possibility of interfering with giving the signal from the rear cars, with the signaling device, by piling trunks and express matter on the cord in the baggage car, as there was with the old continuous cord and gong; so avoid the "tug-of-war" style of signaling employed by some crews. One-second exhaust and two seconds between pulls is a good rule to be guided by.

Train crews are important factors in making a reputation for an engineer handling air-brake trains. Have a respect for them and their coffee pot, else one of their number, after gathering himself from the coalbox and chasing the coffee pot from the other end of the caboose when the shock is over, may brand you as "Stonewall," "Dynamite," or some other appropriate nickname.

All air-braked cars should be switched ahead and used regardless of station order. It allows the engineer to do the work more easily, and in close quarters will save many a pilot and front end, to say nothing of one's job. Air brakes, like a watch, are kept in better condition by being constantly used.

It was a very much disgusted crew which spent about fifteen minutes drilling out three air-brake cars the other day, and upon placing them next the engine found a burst hose on the first car, the cross-over pipe broken off at the triple valve on the second, and a split piston sleeve on the third.

Face the rotary valve to its seat, and finish with as little grinding as possible. The rotary, like throttle valves and plug cocks, is often spoiled by excessive grinding.

Place the air gage so the engineer can see it by night as well as day. If he is not in the habit of watching it now, it will encourage him to become accustomed to. Also keep its face clean.

A properly located engineer's valve is so placed that in applying the brake the lever is pulled toward the engineer; much nicer work can be done with a valve so located than with one where the handle has to be pushed on.

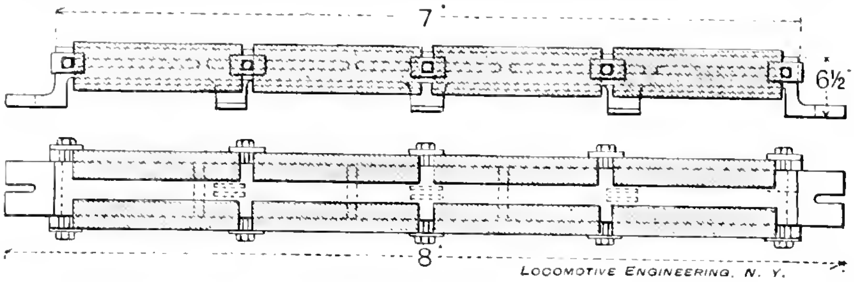
A good piston swab is worth more than all the oil put into the air cylinder.

Drain the main drum often.

Rig for Planing the Flanges of Shoes and Wedges.

The sketch on this page will serve to show up a simple and efficient rig used at the St. Louis shops of the Missouri Pacific for setting and planing the flange faces of shoes and wedges.

The rig consists of a flat bar casting raised on feet and clamped to planer bed at the ends. After shoes or wedges are



planed out to fit the jaws of the frame, they may be placed on the sides of this device, the flange resting on top and clamped at the ends by the bolts shown.

This is all the setting needed; every shoe and wedge flange will be exactly the same thickness; they can be quickly turned over, and the same or any other thickness of flange made on the other side.

This simple device saves time in setting work and insures accuracy.

It is long enough to hold a set of shoes and wedges for an eight-wheeler, or all the shoes or all the wedges of a consolidation engine.

Bil's for Safety Appliances.

Mr. J. H. McConnell, superintendent of motive power and machinery of the Union Pacific, who is wonderfully well posted on details, is quoted in reference to the cost of safety appliances, as follows:

"For the next two and a half years the railroad companies of the United States, in order to comply with the law requiring all freight cars to be equipped with air brakes and automatic couplers, will be required to expend a vast amount of money. At the present time there are 1,250,000 freight cars in service on the various railroads of the country, and 35,000 locomotives. About 60 per cent. of the locomotives are not equipped with the driver brake. Sixty per cent. of the freight cars are not supplied with air brakes or automatic couplers. You will have to apply this equipment to 25,000 cars per month in order to have all the cars properly equipped by January 1, 1898, the time the law goes into effect. It will also require the application of the driver brake to 700 locomotives per month to fulfill the letter of the law. The application of the automatic couplers to the above number of cars will cost the railroad companies $15,000,000, and putting on the air brake to same cars will require the expenditure of $33,000,000. To equip the locomotives with driver brakes will cost about $4,500,000, making a total of $52,500,000.

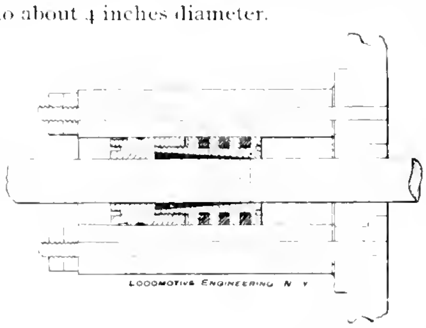
"The application of the automatic coupler costs about $20 per car, and the air brake $15 for each car, while it costs about $200 to apply the driver brake to a locomotive. Efforts will probably be made to have the time extended beyond January 1, 1898. It is generally expected that no extension will be granted, as the trunk roads of the country are spending large sums of money to have their equipment in condition to comply with the law at that time, and when such roads are equipped, it is a natural inference that they will refuse to receive cars from connecting lines unless uniform with their own. This fact alone will compel the smaller roads to put these appliances on their cars in order that they may interchange traffic, otherwise their cars will not be received by the trunk lines.

"The various coupler companies throughout the country report increased orders, while the air-brake people are preparing for the advanced demand that will be made on them for brakes in the next two and a half years. One company alone has facilities for supplying equipment for 250,000 cars annually."

A Novel Valve-Stem Packing.

Mr. D. E. Sullivan, foreman of the U. P. shops at Green River, Wyo., has devised and put into service a novel form of valve-stem packing, which we illustrate herewith.

The gland is replaced by a straight-bored cylinder longer than the valve travel; this makes a steam joint at the chest and holds in place a neck ring of ordinary construction. This cylindrical sleeve is bored out to about 4 inches diameter.



A cast-iron piston, carrying three packing rings, fits the bore of the bush nicely, and is itself bored out on a taper to go over the valve stem. This piston is slipped over the stem and into the bush; then a split taper sleeve is pushed into it, and a nut, the same outside size as the piston, is screwed to the back boss of the piston; this nut increases the bearing surface of the piston, and at the same time forces the taper sleeve into the piston, locking the whole thing fast on the stem.

This piston makes the steam-tight joint, requires no lubrication except what it gets from the chest, and, of course, never wears the stem.

An engine with this packing has been in service about two years.

Straightening Castings.

Sometimes a casting is warped in cooling and requires straightening before being used. If the piece is to be planed or otherwise finished, it should be straightened by heating and placing weights upon it. If it yields to this treatment, it will retain its corrected form after the scale is removed and through all the after processes. But, if the piece is to be used without finishing, it may be straightened by "pening" with the hammer—striking with the "pene" or wedge-shaped end of the machinist's hammer. The process makes a series of indentations on the convex side of the iron, stretching the "skin" of the casting; but when these indentations are removed by after-working, the casting is liable to return to its curved form. In "pening," that portion of the casting that receives the blow should be immediately over the face of the anvil or bench block; in other words, each blow should find a solid resistance, and the casting should be moved along the face of the anvil as the work progresses.—*Exchange.*

The Norfolk & Western Drawing Office.

The best-arranged and best-conducted drawing office I have ever examined is that belonging to the Norfolk & Western Railroad, at Roanoke, Va. The rooms are very commodious, and possess in a high degree the essential requirement of good light. Here originate all the drawings used by the mechanical department of the entire system, and here the originals are stored. Here also are stored all catalogues considered worth keeping, and a variety of other papers and documents containing information of value to the department.

The making of drawings is a commonplace operation, and the storing of them in drawers cannot be called a novel proceeding; but keeping a record of what drawings have been made, and where the originals are to be found on a moment's notice, and also where all blueprints have been sent, is something worthy of being generally known. This achievement has been accomplished by Mr. G. R. Henderson, mechanical engineer of the Norfolk & Western, in the drawing office which is under his charge. Not only can the information be immediately obtained of what drawings have been made of any particular part of mechanism and where they are to be found, but all information on file on any subject is as readily found.

All drawings are first made in pencil, from which tracings are taken, the tracing constituting the standard drawing and source of reference. These tracings are all stored in a fireproof vault. When a tracing is finished, and has passed the rigid inspection of the mechanical engineer and his assistant, the draftsman consults a book for the serial number under which it will be entered, marks the number upon the drawing, and enters the drawing in the record book. Letters of the alphabet are used to designate the sizes of the drawings. A, the smallest, is 8 x 11 inches; G, the largest, is 35 x 59 inches. If the draftsman has finished a drawing of the latter size, and the serial number is, say, 3000, that drawing will be known as G 3000, the letter doing the double duty of distinguishing the size and the drawer where the drawing is filed. Before putting away the tracing, the draftsman makes out an index card which indicates the subject of the drawing, and if the drawing was made for any special locality or party, the name is given. In entering the subject of the drawing, care is taken to make identification easy. For instance, a drawing has been made for a transfer table for Shenandoah shops. The index will read on different lines: Transfer table for Shenandoah machine shop; Table (transfer) for Shenandoah machine shop; Shenandoah machine shop, transfer table for. These particulars are entered on the index cards in the usual way.

There is one peculiarity, however, about the index cards used. When a drawing originates on the Norfolk & Western, particulars for identification are entered on a buff-colored card, unless it be of something intended for a particular place, such as a crane for Shenandoah machine shop, when it will be indexed on a blue card. When drawings, which it is desirable to file, are received from a foreign road, their particulars are indexed on a pink card.

If the drawing relates to a new standard, or to a change on an established one, blueprints are sent to all the master mechanics, master car builders or others concerned in the maintenance of standards. Pinned to each blueprint is a receipt, which the receiver signs and returns to the superintendent of motive power. This receipt becomes a subject of record, and not only shows where the blueprints have been received, but is evidence that all interested have the information that enables them to maintain the standards.

The record of the number of blueprints sent out is also kept by card index. When it has been determined to make a change on a drawing, all the blueprints of the old one are called in, and new prints embodying the change sent out.

Catalogues and papers or books containing information likely to be of service to the mechanical department are filed in a very convenient form, and indexed in much the same way as the drawings are. Pamphlets and leaves are arranged in Globe files, and books are shelved in company with others of a similar character. The shelves are conveniently divided into compartments where matter relating to one subject is deposited. Each catalogue, pamphlet, leaflet or book is lettered and numbered according to the file or compartment it belongs to. The system places a wonderful amount of useful information in a shape where it is readily found.

The company has a remarkably complete list of standard specifications for material. These are kept by Mr. Henderson, and are filed like the drawings. When changes are made a copy of the old specifications is retained, and a notification put on giving the reasons for the change.

Limited space prevents me from giving more than an outline of the finely organized drawing office of the Norfolk & Western. If any head of a mechanical department finds that his drawing office is not run on a systematic basis, I should advise him to send his chief draftsman to spend a few days with Mr. Henderson at Roanoke.

A. S.

Favors the Feed-Water Heater.

Testimony was given by Mr. J. H. McConnell, of the Union Pacific, to a committee of the Master Mechanics' Association, on "Causes of Bulging of Flue Sheets," which is calculated to bring back feed-water heaters into favor. He said: "We have probably as great a variety of water as any road in this country, some water containing as high as 136 grains of solid matter to the gallon.

"Numerous experiments have been tried to neutralize the bad water, by the use of boiler compounds, by the use of zinc in the leg of the boiler, made in the shape of a casting like those used in a telegraph battery, and hung on one of the stay-bolts. The action of the water on this zinc, in running 600 miles, has been found to have entirely destroyed and eaten up the zinc. It had a tendency to soften the scale, but did not prevent the engine from foaming. Have also experimented at one point with a combination of soda and lime—a certain portion to the 1,000 gallons—by pumping it into the station tank, which has neutralized to a certain extent the scale-producing properties of the water, converting it into a non-producing and scale depositing it into the bottom of the boiler.

"The most successful method of taking care of our boilers in bad-water districts has been by the application of the Rushforth feed-water heater. Have now about fifty of these in successful operation. Results have been very satisfactory. On the Seventh district of the Wyoming division, where the water is largely soda, it has been our practice, and an absolute necessity, to wash the boilers out after making a trip of 137 miles. This practice has been in operation for the past twenty-five years, and until the heaters were applied to the engines. Since the application of the heaters, the engines run over that district thirty days without washing the boilers.

"One engine has run seventy-two days successfully without changing the water in the boiler. By this plan we have been enabled to open up the nozzle ¼ inch, the engines steam freer and carry water well on the hills. Previous to the use of the heaters, the engines foamed going over the road, and it was necessary to let the water run down very low in the boiler in order to get over the hills. Frequently the engines struck the foot of the hill with but 1 inch of water in the glass, and on the hard pull the water would go to the top of the glass and sometimes out of the stack. In a great many cases the engine foamed so badly it was necessary to shut off and stall and double over the hill. With the heaters the engines carry 3 inches of solid water in the glass, shut off, and when worked hard on the hills do not foam. The engines are equipped with four blow-off cocks—one in the cylinder part of the boiler behind the front flue sheet, one in front of the leg, and one at each back corner of the leg. Our blow-off cocks are equipped with air valves, which are opened and closed by air. All of the connections are fastened to the boiler head, and operated by the engineer or fireman in the same manner as the engineer's valve; by simply turning the handle of each valve the blow-off cock is opened, and by turning it back the air pressure closes it. We find this works very successfully. The engines are blown out at each end of the division, and also once or twice going over the division. It has reduced our boiler work at that point, and the engine is always ready for service and can be turned around and sent out immediately; while previous to the adoption of the heater we always counted on laying the engine up from five to seven hours at each end of the division, in order to wash the boiler out and prepare it for the road.

"On one of the other districts, where the water is of an average quality, we have run an engine 20,000 miles without washing the boiler, and examination has shown there was no mud or scale to be found either in leg of boiler or cylinder part.

"This plan has proven to us to be the best and most satisfactory way of handling bad water of anything ever tried here."

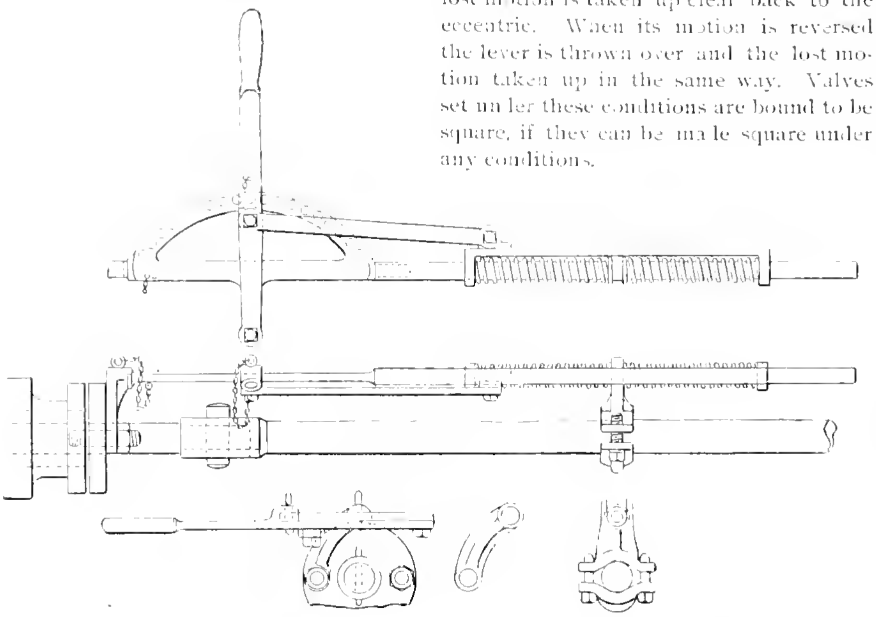
Some of the people who engineered the "Raub" locomotive building-site frauds a few years ago, have been working up a new deal at Anderson, Ind. The Anderson *Daily Bulletin* lends itself to the scheme, and booms *Elder* Covert and his new "Culver" locomotive, that is to have three boilers, eight cylinders and run 100 miles an hour.

This is a pup out of the old "Raub" engine, and the "Raub" schemers are behind it. Their plan is to sell lots and promise to build works to turn out locomotives to perform miracles. The people who wrote the description of this wonderful engine are as ignorant of the principles of the steam engine as a Hottentot.

Lost-Motion Adjuster for Valve Setting.

Any mechanic who has had experience in locomotive valve setting, knows that it is quite unsafe to bet on getting valves square on a cold engine, and nine out of ten are neither satisfied nor successful until they "run 'em over with steam on."

Waiting for a favorable opportunity to



use steam, and then chasing the engine around the yard, wastes much time and patience, but before valves are square, that lost motion must be accounted for and taken care of.

Our engraving shows a machine for taking up the lost motion—just as it is when engine is under steam. Valves can be set with this device on a cold engine, or on one nearly worn out, with no fears for the results. It is the invention of F. W. Williams, of the Minneapolis & St. Louis road, and is being placed on the market by the Q. & C. Co., of Chicago.

What may be termed the frame of the machine is a pipe with a ribbed sleeve sliding loose on it, and each side of this sleeve a strong coiled spring, both springs being held at the outer ends by one yoke; if this yoke is moved one way it causes one spring to push against the sleeve in one direction, and if moved the other way it causes the other spring to push the sleeve in the opposite direction. This yoke is connected by a rod to a lever that is fulcrumed on a lug of the frame, and having a quadrant on the other side, with retaining pin to keep in tension either spring desired.

The end of the frame has a boss that enters a lug held by one of the stuffing-box bolts. The end away from the chest is supported by a fork that encircles the sleeve, and is itself clamped to the valve stem.

There is a small key that keeps the lever in a horizontal position, and toward the operator, no matter on which side of the engine the machine is used, and serves to hold the front of machine for the pull. It is plain that by moving the lever one way or the other, the valve stem cannot be moved without compressing one of the springs, and this takes up any lost motion just the same as would a load on the valve.

When the stem is coming out of the chest the spring is set to retard it, and all the lost motion is taken up clear back to the eccentric. When its motion is reversed the lever is thrown over and the lost motion taken up in the same way. Valves set under these conditions are bound to be square, if they can be made square under any conditions.

Press Forging.

The distinction between melted metal flowing into molds by gravity and being forced into molds by pressure, when only softened by heat, is not so great as people imagine. The first is as old as civilization; the latter is a new process, developed and made possible by implements of recent invention. All over the world, press forging is increasing. Presses to exert thousands of tons are now common, and the most intricate forms are produced by the flow of metal heated only to redness, the same as it would be for hammering.

The latest thing in such forgings are railway axles. Blanks of a uniform section are placed in dies which form a matrix, having the form of a completed axle, with its necks and collars. Powerful plungers driven by hydraulic force, act on the ends of the blank, forcing or "flowing" it into the mold, just as castings are made of fluid metal. The work demands celerity to prevent cooling by radiation, but the process is, no doubt, a practical and economical one.—*Exchange.*

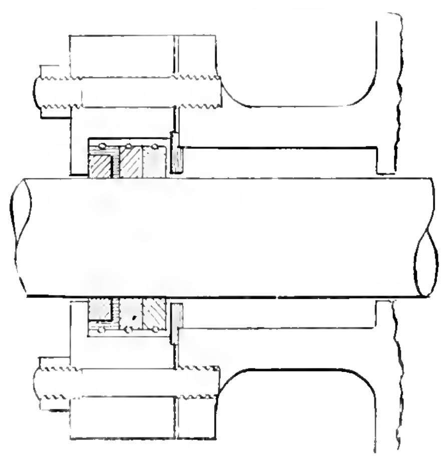
The Crabtree Metallic Packing.

This packing is the invention of Mr. Thomas Crabtree, a machinist, at McCook, Neb. It consists of a combination ring and two follower rings. The combination ring consists of two rings, male and female, each cut in half, each half being less than a half circle, the sections of the male ring being so placed with relation to the sections of the female ring that none of the intersections of the rings register in line, and are held in such position by a dowel pin.

The combination rings are held in place around the rod by a No. 10 gage steel-wire ring. The two follower rings are each cut in half, each half being less than a half circle, each ring being held in its place around the rod by the same kind of wire ring used on the combination ring. The set of rings described are inclosed within the piston-rod gland or stuffing box of cylinder or steam chest.

The combination ring of this packing is also being used without follower rings, by making it heavier, about $1\frac{1}{2}$ inches long, and it is giving results equally as good as with the full number of rings. This packing has been used with success against steam, air and water. It has been run on Westinghouse air pumps, worked at highest possible speed, and never runs warm, never leaks or blows, and the pumps run very freely.

A set of this packing has been in constant service on piston rods and valve stems of a Rogers mogul engine, 180 lbs. boiler pressure, for thirteen consecutive months, during which time the engine has made 52,000 miles, and the packing has not, during the entire period, been replaced or repaired in any way, shape or manner, nor have the rods been turned since packing was applied. It has been examined twice since applied; once after six months' service, and the second time at the end of thirteen months' service. At the second examination it was found to be in perfect condition, and good for eighteen to twenty months' more service before it would be worn out. All Crabtree packing which has been applied to engines of any kind has given the same good results, and none



has ever been removed for causes due to defects.

After thirteen months' continuous use of this packing on piston rods and valve stems, they show no more wear than the loss of metal in taking a fine polish, have no shoulders on them, and will not consequently require turning when the engines are shopped for a general overhauling of machinery.

This packing is being placed on the market by the Crabtree Metallic Packing Co., of McCook, Neb.

Col. Haines on European Railways.

The Western Railway Club resumed its meetings, after the summer recess, last month, and had a grand banquet in the evening, which was attended by many prominent railroad men. The strong feature of the banquet was an address by Col. H. S. Haines, on his attendance at the International Railway Congress.

He spoke of European railway locomotives as "toys," but was impressed with the solid track and substantial permanent structures. After discussing various phases of European railways, he said:

"But there is one point upon which I wish to lay particular stress, and that is the evident lack of appreciation among European railway officials of the merits of American methods. This was brought out forcibly in the discussions in the section termed 'Light Railways.'

"They feel over there that even in those thickly populated countries there are still extensive areas insufficiently provided with railroad facilities because the present traffic will not justify the cost of construction and operation in accordance with their recognized standards, and it was evident that those interested looked to the congress for an expression of opinion as to the feasibility of relaxing these restrictions for the encouragement of such projects.

"Here seemed to be the opportunity for the application of American experience. Yet, while the information offered by the American delegates was received with respect, it made no impression as bearing on their own necessities.

"This was the great lesson that we learned by our presence at the congress, that the majority of the influential railroad engineers and managers of Europe are not favorably impressed with American practice. They recognize that a few of our trunk lines have approached the perfection which they have attained in Europe, but as to nine-tenths of our mileage, they look upon it as what they term 'Light Railways,' hardly suitable for feeders for their principal lines.

"Now, is there not food for thought in this statement? Is there not among European railroad experts a field for some missionary work in behalf of the American system? I may be answered that it is no concern of ours to enlighten our European cousins as to how they should construct and manage their railroads.

"But there is another view to be taken of this matter; one which is of great importance to American engineers, to American manufacturers of railway material and to holders of American railway securities, and to which I call your serious attention.

"Within the past thirty years there have been more miles of railway built in this country than the total mileage of Europe to-day. With the aid afforded by that mileage the population of our country has, in the meantime, nearly doubled and its exports have trebled. Yet all this has been accomplished by methods which, in the eyes of European railway managers, are substantially inadmissible, even with feeders for their main lines.

"Before I attended the London meeting I might have thought that while this was rather mortifying to our pride, yet it was a matter of no great interest to us. But I do not now. It is not enough for us to say—Let the Europeans manage their railroads their way and we will manage ours in our way. It might be, if there were no roads to be built anywhere else, but the blessings of civilization are yet to be spread over two-thirds of the globe, and on what system shall the railways be built that are to carry them? The European system is intended to provide improved facilities for existing traffic; the American system to provide facilities for creating the traffic itself; and this is the work that is to be done in South America, Africa, Asia and Australia, while the money to do it with is to be provided from the surplus fund lying idle in London and in the other great money centers of Europe. Wherever this work is done on the European system, American methods, American railroad men and American railway materials are barred. Is it then of no concern to us to enlighten our European professional brethren as to what the American railway system really is—of its greater adaptability to the needs of a new country than that with which they are familiar? And how can this be better done than by inviting them to come here and see for themselves the great work that the American system has accomplished?"

Col. Haines concluded by proposing that the Western Railway Club invite the International Railway Congress to meet in Chicago within the next two years.

Timely Words from President West.

At the September meeting of the New York Railroad Club President West opened with a few timely remarks, among other things saying as follows:

* * * "There are unmistakable evidences of a revival of business throughout the country, which should bring smiles to the faces of our supply friends, and which will result in gladdening the hearts of every man connected with the operating department of our railroads. The past year has been a very trying one to all of us in endeavoring to maintain the properties which we represent, and at the same time keep within the limits of the appropriations allowed for doing so. Federal and State laws are constantly calling upon our railroads to expend large sums of money in safety devices. Since we last met probably two million grab-irons have been applied to the freight cars of our country, at an estimated cost of twenty cents each, which will represent two hundred thousand dollars. It is safe to say that ninety per cent. of this amount has come from the appropriations set aside by us for our legitimate repairs. It seems to me that we have still a greater problem to solve in the next two and a half years, in the matter of the application of automatic couplers and air brakes.

"In an article in the *Railroad Car Journal* this sum was placed at eighteen million dollars as an estimate of the cost of equipping the balance of the cars with automatic couplers, and twenty-three million dollars as the cost of applying the air brakes, which would make the total sum forty-one million dollars. Probably not more than eleven million dollars of that amount have been already expended, leaving a balance of at least thirty million dollars to be expended in the next two and a quarter years, in the application of air brakes and automatic couplers.

"I would like to see the New York Railroad Club inaugurate a movement which would result in handling this matter in much better shape than the matter of grab-irons was handled, and if possible prevent so pitiable an exhibition of ignorance of the law as was given in Washington in July last, when a large number of railroad men went before the Interstate Commerce Commission to discuss the grab-iron law; and statements made at Alexandria Bay in June, and at Washington in July, gave evidence that not one of the roads of the country had complied with the law relative to grab-irons. It seems to me that we could do no better work for the companies which we represent than to get these matters into such shape between now and the time that the law expires, by discussion, as to place them in their proper light. If we save five per cent. of this cost in the application, it would represent $1,500,000."

The Traveling Engineers.

The Traveling Engineers held their convention in Pittsburgh on September 10th, 11th and 12th.

There was a fair attendance—about half the total membership—and, though the weather was dreadfully hot, the meetings were well attended.

The papers presented were good ones; the one on "The Art of Air-Braking, from an Engineer's Standpoint—that is to say, the Care and Manipulation of the Engine Equipment," was especially strong and forceful.

The doors of the association were opened a little wider by amending the constitution so as to admit general foremen and roundhouse foremen who have had road experience as engineers.

The exchange of ideas and experience is the most valuable part of these meetings, although the best of it does not find its way into the printed proceedings.

The members visited in a body the Westinghouse Air-Brake Works at Wilmerding, the Pittsburgh Locomotive Works, and the Galena Oil Works at Franklin.

All the old officers were re-elected. The next meeting will be held in Minneapolis, Minn.

Presentation to Mr. C. A. Smith.

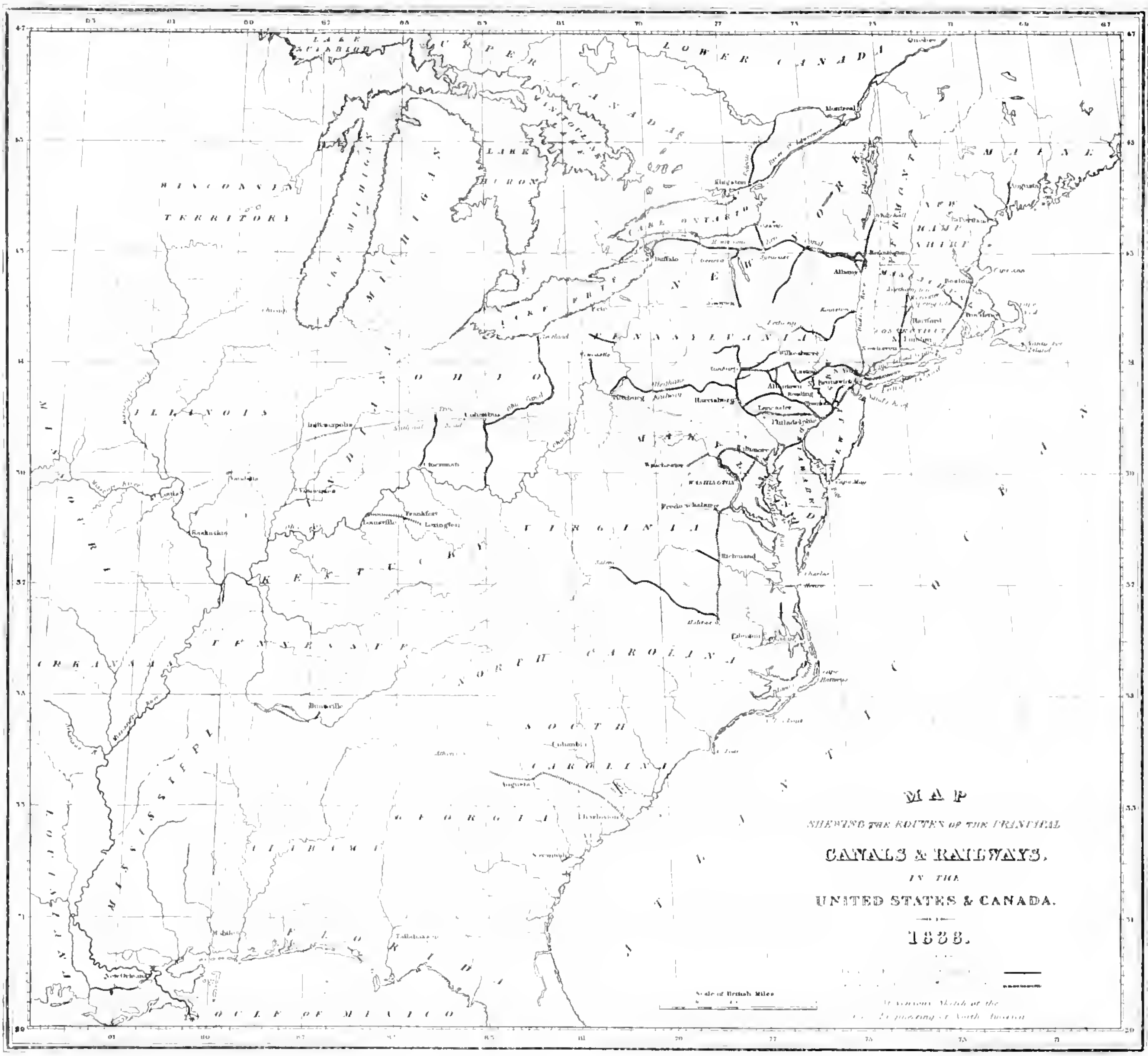
A very pleasant personal incident was witnessed by those present at the last meeting of the New York Railroad Club. After the opening preliminaries were finished President West invited the treasurer, Mr. C. A. Smith, to take a seat in front, and then the veteran M. C. B., Mr. F. D. Adams, proceeded to tell the meeting how much Mr. Smith had done for the M. C. B. Association and for the New York Railroad Club. Mr. Smith was for many years secretary, without salary, of the M. C. B. Association, and carried on its business by his personal credit. He was also for years the mainstay of the New York Railroad Club.

Mr. Adams intimated that although the M. C. B. Association, as an organization, had never manifested any appreciation of the valuable services rendered by Mr. Smith, the individual members were more just. As representative of these members, Mr. Adams said: "We have concluded that some more should be done. It is recorded in Holy Writ that a certain king at one time was reminded of the services of one of his subjects. The king then ordered that this subject should be clothed in purple and fine linen as a mark that he was one whom the king delighted to honor. We are not going to clothe you in that way," said Mr. Adams, "but we delight to honor you, and the token is this badge which I now present to you." A very handsome gold badge with a diamond glittering in the center was then presented to Mr. Smith.

Owing to the frequent breakage of cast-iron eccentric straps, the Philadelphia & Reading are making the eccentric straps of all their passenger engines of brass with a soft metal lining. The straps are considerably lighter than the iron ones, but they stand the strains much better. A good feature about a brass eccentric strap is, that when it begins to heat it expands more than the eccentric sheave, and thereby relieves itself. Of course brass is much stronger than cast iron.

American Railroads in 1838.

The interesting map shown herewith was published in 1838 in a book on "Civil Engineering of North America," by David Stevenson, a Scotch civil engineer who had spent three months traveling in the United States the previous year. The map shows all the railways and canals on this continent at that time. It will be seen that New York had only one railway connection, and that was with Long Island.



The South Carolina Railroad was then the longest on the continent, and the longest in the world at that time.

The railroad that ran farthest west was in Alabama, and did not connect any towns, but was evidently intended to make connection between two points of navigation.

The details are well worthy of study. We are indebted to Mr. A. G. Leonard, secretary to Vice-President Webb, of the New York Central Railroad, for the loan of the book containing this map.

CAR DEPARTMENT.

Conducted by Orville H. Reynolds, M. E.

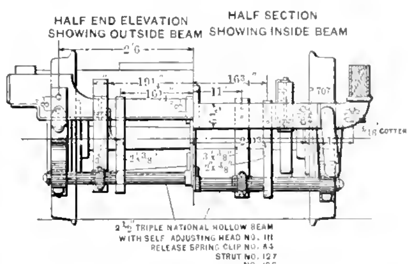
Six-Wheeled Truck.

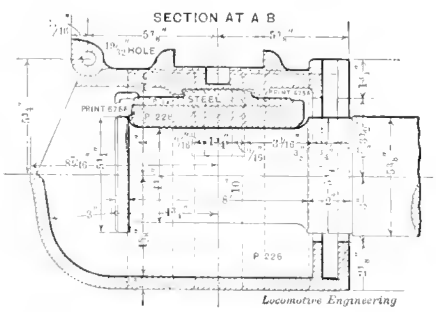
The Baltimore & Ohio trucks illustrated herewith partake of all the strong points of the bodies they carry. They are six-wheelers, with 33-in. Paige wheels. The axles are the M. C. B. 4¼ x 8-in., with collared journals, 6 ft. 3 in. centers. Strength and fitness for long-continued hard service are conspicuous features of the framing of these trucks. The 3¾ x 7-in. oak wheel pieces are plated on both sides with ⅜ x 7-in. wrought-iron plates, the inside plates having a foot 3 in. long, turning on and secured to the end pieces. At the junction of the wheel pieces and end pieces there are pressed-steel corner plates, each taking one of the pedestal bolts and extending to the end of wheel piece, where they are made to span the sides, and with a flange at each side they are secured to the end pieces.

With the corners so well reinforced, these frames are stiff enough to stay square after they are turned out of the shop ; the need of this is well recognized in the introduction of the three corner plates and the ⅜ x 4-in. wrought-iron binder running the full length of end pieces. All tendency to distortion is met with metal at the point where it is likely to occur, and the prospect of wheels with excessive flange wear is thus reduced to the vanishing point.

The same frame is standard for both 33 and 36 in. wheels. With the 33-in. wheels, the two outside brake beams are of oak 3 x 7½ in., and have ¼ x 7-in. wrought-iron plates on top and bottom. The center beam is the Westinghouse. An all-metal beam is used at each wheel on the truck having 36-in. wheels. A good point is scored here in making each wheel do its share of braking, standing out prominently as an exception to a practice that should be discontinued, for it is notorious that too few of our six-wheel trucks have a shoe at each wheel. This is one case where they did not wait for the want to be *felt*, but builded at the start to get that other 33⅓ per cent. of braking power.

The style of journal-bearing key and method of seating it in the box is a noticeable departure from what is seen in ordinary practice. The key is a steel casting made to fit on the journal bearing in the usual way, and is held in position, not by its front end shouldering against a lug in the outer end of box as in the old way, but by seating between two lugs ¼ in. deep, cast centrally under the equalizer bearing, the key having a bearing ⅜ in. high and 3 in. long at about the center of its length, to fit between the lugs on inside of box. The top of this bearing on key is curved to a radius of 24 in. in the direction of its length, which ought to center the load on journals under any condition of track. The journal bearing is lined with lead made over a former ⅛ in. larger in diameter than the journal which carries it—a practice known to be one of the best preventives of heating, and largely followed by the best authorities on the subject of hot boxes. While these six-wheeled trucks do not contain many radical departures from well-established and familiar lines (to be expected with this type of framing), they do embody the very latest and best approved points in construction which have the remotest bearing on length of service and reduced cost of maintenance.





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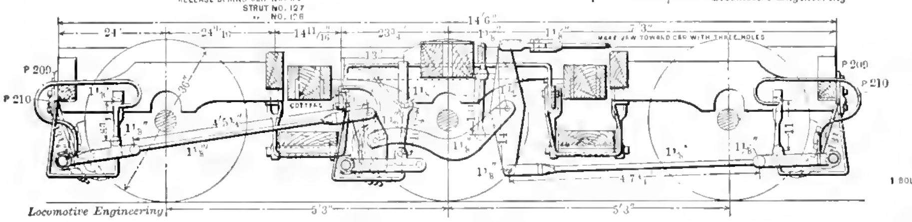

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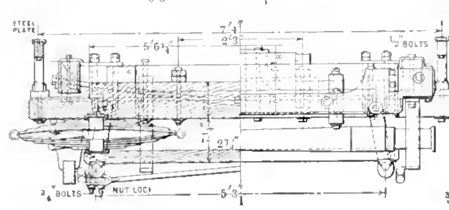

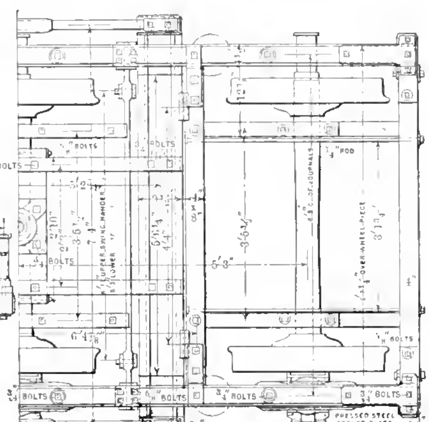

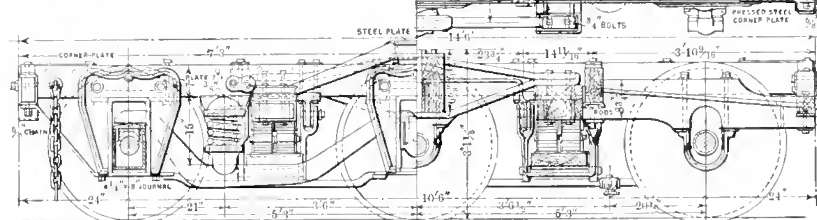

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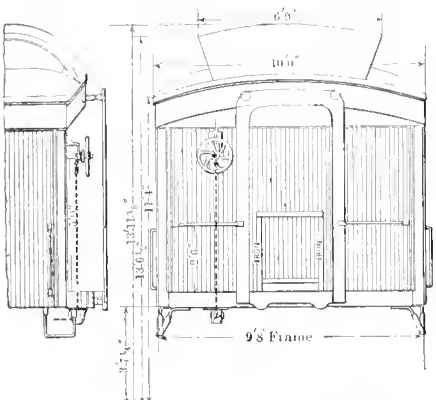
The Stationary Engineers' Gazetteer is the title of a list of men in charge of steam plants in the State of Illinois, together with information about size of plant. It is issued by the Stationary Engineers' Gazetteer Association, at Chicago.

Strengthening of Ends of Passenger-Train Cars.

The Master Car Builders' Committee at work on this question of strengthening of passenger-car ends and platforms have reported the status of the situation, and have been continued, in order to await developments well under way, and which bid fair to assume form enough out of the present void to warrant a report next year from which valuable conclusions can be drawn. In the meantime there will be a lively interest taken by those who are putting up new equipment, to see what can be done to make the ends of passenger cars safer against shocks, or, to put it plainly, to reduce the probability of telescoping in the event of collision.

At this time there are some roads engaged in the solution of this strengthening problem, among which are the Baltimore & Ohio, whose superintendent of car department, Mr. Grieves, is chairman of the committee referred to above. It is fair to assume, therefore, that they will not allow their work to suffer by comparison with



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that which is now completed, or which will follow as the result of investigation in this direction. The Baltimore & Ohio are building some 60-ft. postal cars, and in these will be worked out some advanced ideas, among which is the abolition of the old platforms and steps, while closely following the recommendations of the United States Government in its requirements for stronger ends and framing for cars in the postal service. The under-framing of these cars is exceptionally strong, as will be noted by a reference to our engravings, for which we are indebted to the Baltimore & Ohio car department. Every line tells of the purpose evidently kept foremost in view—to have a construction giving a reasonable assurance of safety against violent shocks.

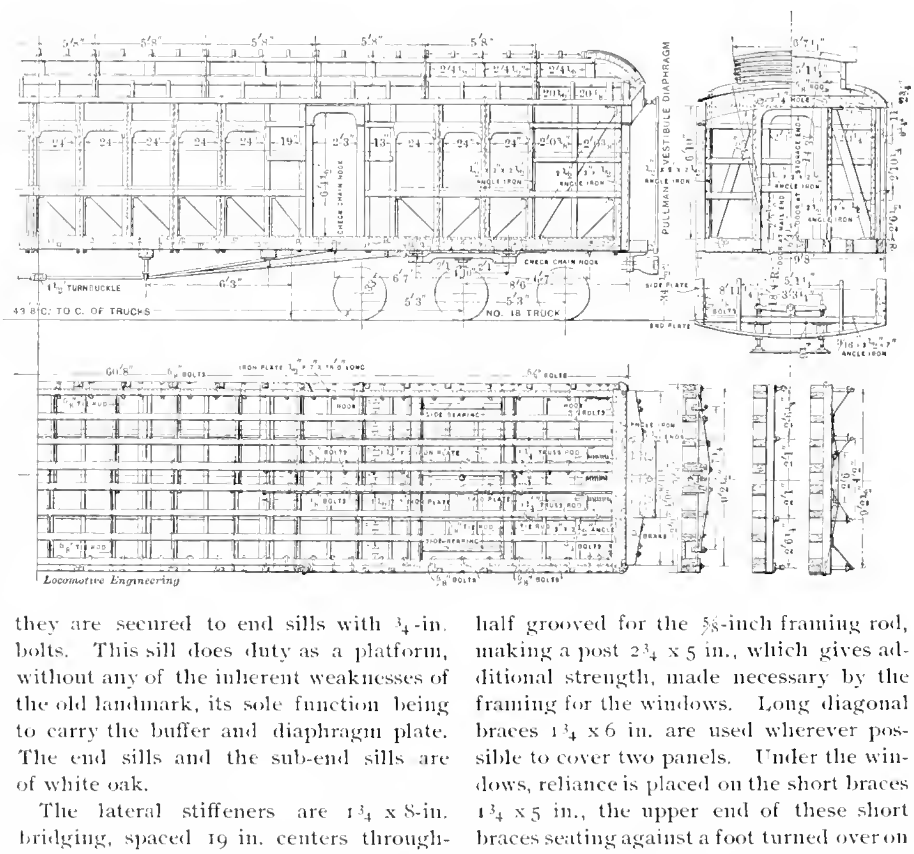
There are two outside sills 4 x 8 in., bolted together with $\frac{5}{8}$-in. bolts, making a sill equal to 8 x 8 in.; a wrought-iron plate $\frac{1}{2}$ x 7 in. is placed between these sills, extending 18 ft. back from the end sill; the inner side sill being gained full thickness of the iron. The four intermediate sills are also 4 x 8 in. The center sills are 5 x 8 in., and have a $\frac{1}{2}$ x 7 in. wrought-iron plate 18 ft. long, secured to outer face of sills; one end of each plate is bent at right angles, forming a foot 8 in. long, which abuts against inside face of end sill. The plates are secured to side and end sills by $\frac{5}{8}$-in. bolts, and by $\frac{3}{4}$-in. bolts through end sill and sub-end sill—each sill, excepting that at outside, having $1\frac{3}{8}$-in. double tenons $1\frac{1}{2}$ in. long. All these sills are yellow pine, and each one a continuous piece; no splices allowed. The end sills are 8 x 8 in., mortised to receive the double tenons on longitudinal sills, and also for the end posts; they are secured to outside sills with a $\frac{3}{4}$ x 7-in. wrought-iron angle plate, bolted with $\frac{3}{4}$-in. bolts to inner corner of sills, the end bolts passing through both end sill and sub-end sill. In addition to this there is an angle iron $\frac{3}{4}$ x 6 x 6 in. gained flush into outer face of end sill, and $\frac{1}{4}$ in. into bottom face of same, extending full length of sill. The sub-end sills—and here is a notable good-bye to time-honored lines—are 7 x 12 in. at the center, reduced to 7 x $6\frac{1}{2}$ in. at the ends, and have a wrought-iron plate $\frac{3}{8}$ in. thick and 5 ft. 4 in. long on outer face; they are secured to end sills with $\frac{3}{4}$-in. bolts. This sill does duty as a platform, without any of the inherent weaknesses of the old landmark, its sole function being to carry the buffer and diaphragm plate. The end sills and the sub-end sills are of white oak.

The lateral stiffeners are $1\frac{3}{4}$ x 8-in. bridging, spaced 19 in. centers throughout the center of the car, up to the body bolsters, where the two pieces immediately over bolsters are 6 x 8 in.; all these bridgings are tenoned into the sills with $1\frac{1}{4}$-in. double tenons, and securely tied with $\frac{5}{8}$-in. framing rods from each side to the opposite center sill, except at the bolsters, where they pass through from side to side of car.

This method of tying by passing the rods from farther center sill to opposite side of car is an innovation—at least, not common practice. The half plan explains more clearly than words the resisting powers of this combination of wood and iron.

The framing of the superstructure is put up on a basis equally as substantial as that below it; and this is accomplished by the union of metal and wood, together with superior judgment. The corner posts are 5 x 5 in., rounded on the outer face; to these are secured side and end body posts $2\frac{3}{4}$ x 3 and 3 x 3 in., respectively, which are rabbeted on the face next to inside lining to receive a $\frac{1}{2}$ x 2 x $2\frac{1}{2}$ angle iron. This angle iron is fastened to the posts by $1\frac{1}{2}$ No. 14 screws, and the ends are turned over, making a foot 8 in. long, by which the angle iron is secured to top of sill and bottom of plate. The $\frac{5}{8}$-in. framing rods through sill and plate bind the whole combination firmly together. This construction is carried out also on the third side posts, the foot on the angles forming a seat for the diagonal braces at the corners. The end door posts have at the sides a 3 x 5 end post, with an angle iron and post rod the same as at corner posts.

The window posts are in two pieces, each



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half grooved for the $\frac{5}{8}$-inch framing rod, making a post $2\frac{3}{4}$ x 5 in., which gives additional strength, made necessary by the framing for the windows. Long diagonal braces $1\frac{3}{4}$ x 6 in. are used wherever possible to cover two panels. Under the windows, reliance is placed on the short braces $1\frac{3}{4}$ x 5 in., the upper end of these short braces seating against a foot turned over on the end of the $\frac{5}{8}$-inch rod passing through sill; this makes it possible to keep these braces under compression at all times.

The $\frac{5}{8}$ x 2-in. wrought-iron members of the compound carlines are secured to plate and deck sills with a $\frac{3}{8}$-in. eyebolt at each side of carline. This is fully as strong, and certainly cheaper than the old method of forging a double foot on at ends.

The yellow pine end plates 3 x $14\frac{7}{8}$ in. are reinforced by an angle iron $\frac{9}{16}$ x $3\frac{1}{2}$ x 7 in., placed at the bottom and on inside face of plates; the ends of this angle iron

are bent at right angles to the body and extend 14 in. on side plates, and secured to both plates by ¾-inch bolts. These details of body framing are shown in section, telling a story of painstaking care in the drawing room, in placing on record these important improvements on old constructive problems.

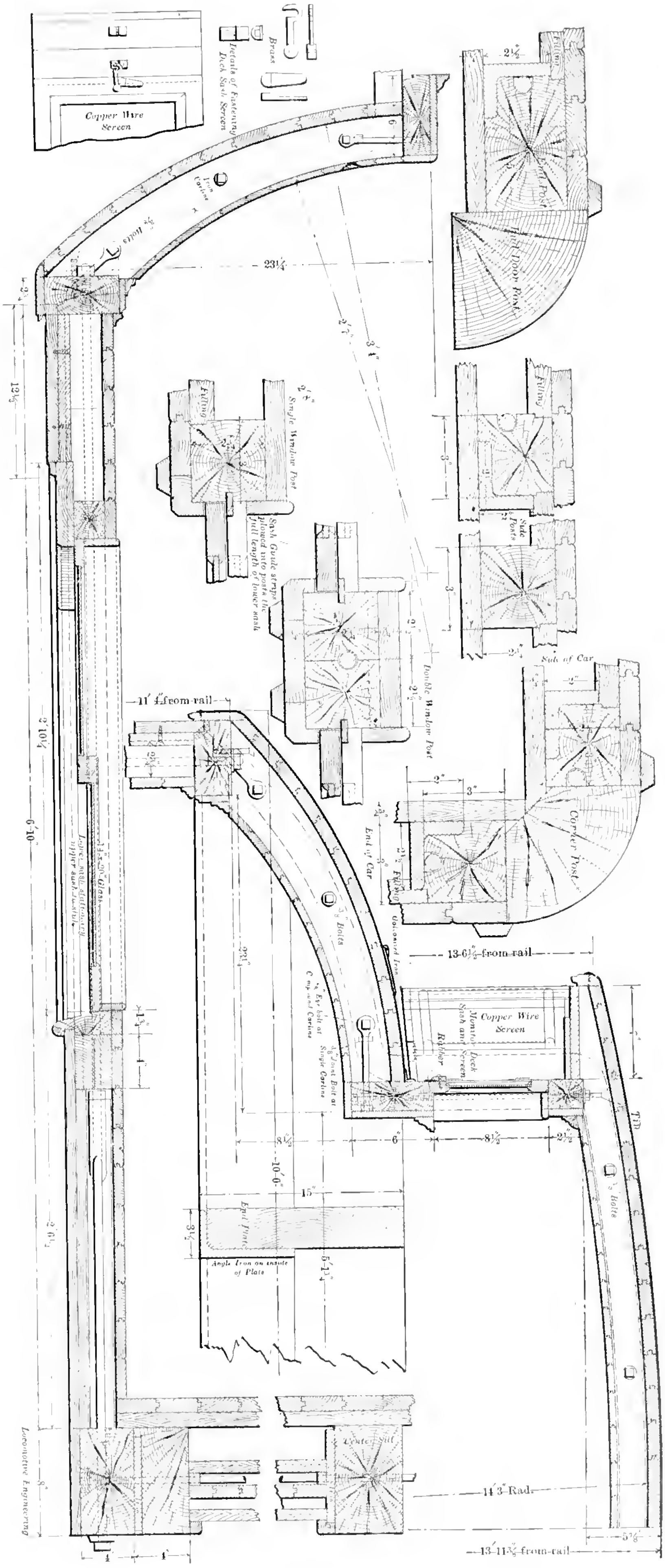
The roof finish at end of car has a tasty appearance; the end-face carline starting in line with the corner posts and curving to the center, so as to stand 9¾ in. from end plate. A Pullman vestibule plate without the rubber diaphragm is secured to the buffer plate, and attached to the springs and equalizer. The hand-brake wheel has found a lodgement on the end of car at a convenient height. The wheel is supported in a vertical plane by a neat cast-iron bracket secured to end of car, and about 8 in. from sheathing. The brake chain passes down through sub-end sill and around a sheave to the pull rod. These features, briefly touched upon in detail, convey a lesson in the march of improvement that probably reveals the beginning of the end of some traditions that have perhaps been too piously preserved.

Bad Work in the Mill.

A box car not long enough in service for the white stencil to assume the tan only seen on the battle-scarred veteran, was found in the hands of a repair gang a few days since, who were trying to diagnose a case of sheathing pulling off the nails at the crossing of sills, in the panel between bolsters and needle beams. After the sheathing was removed at these points, it was found that the outside faces of posts and post pockets were not in line with the face of sill, as they should be, and were when sheathing was nailed to place.

Further investigation showed the cause of trouble to be in the size of holes for post rods, and the mortise for lugs on the bottom of post pockets—too large in both cases. It was plain that a shifting load had got in its work; it was also patent that if a little more care had been exercised to make holes and mortises of correct size instead of *big enough*, the doctors on the repair track would not have been called. The lesson furnished in this instance is to either have inspectors at the works when erection of cars is under way, or to "so nominate it in the bond" that the builder would find it unprofitable to turn out candidates for the dissecting table. There are places enough in car construction where close attention to sizes need not be insisted on, but this is not one of them.

In all places where good alignment and tight work is required, there should be the proper care given to produce it; if this cannot be done, it were better to return to the old practice of tenons on the posts, where a fit is usually made in the mortise as a matter of pride. This would insure a flush face at sill, post and plate, and prevent to a large extent the bulging of sheathing so often seen.



Notes from Altoona Shops.

The Pennsylvania Railroad shops at Altoona, like all shops that have been increased away beyond the original design, have many inconvenient features. During a recent visit to these shops I found the highly energetic superintendent, Mr. J. M. Wallis, wrestling with the problem of overcoming the natural shortcomings of the establishment. His greatest desire seems to be more light, and he is scheming changes in the shops that will dispel a great share of the darkness that makes artificial light necessary in daytime. There are also changes making that will greatly reduce the labor of handling material. Among the improvements going on is the building of a new laboratory. Old tools are being replaced by modern ones better adapted to the heavy work of to-day, and devices for handling material are being introduced.

The most convenient shops belonging to this establishment are the iron and brass foundries. The latter has been rearranged lately, and it is now the most convenient brass foundry that I have seen. In connection with this foundry I noticed a practice which is worthy of imitation. It is well known that among the old bearings sent in as scrap there are often good brasses which ought to be returned to service. Here a man goes carefully over all the scrap, and selects the brasses that are too good to melt up. It was formerly the practice of the company to sell all the old brass, but they are not doing that any longer. They melt the old brass in a cupola and pour it into ingots. These are analyzed, and new material is added to make up the standard mixture. They find that the bearings made from the old brass wear as well and run as cool as bearings made from new material.

For a long time this company was annoyed, as are most other roads, with hard oxidized spots in brasses which caused them to run hot. All sorts of mixtures were tried to overcome this defect, but without success, until some one suggested that the oxidization took place on the surface of the molten metal before it was poured. To prevent this, powdered charcoal was applied to the surface of the metal, and it proved an entire remedy. The practice is now followed regularly, and hard spots on brasses are unknown.

Until lately, natural draft was employed for the crucible furnaces. As melting was rather slow, Mr. Wallis applied a light forced draft, and by the change reduced the time of melting from 90 minutes to 50 minutes.

They have the best spring-making shop here that I have seen anywhere, except at the A. French Spring Works. In fact, the tools and methods employed are the same as those used in the French shops. After the springs are finished they are all tested for strength and flexibility. Those of the same degree of flexibility are then grouped together. When they are put in service, this care in selection results in making all the springs take a uniform share of the load. This is a detail which has received too little attention. The usual plan is to select springs merely owing to size. It often happens that a stiff spring and a flexible spring will be opposite each other, and a hard-riding locomotive or car is the result.

That annoying problem, "the handling of ashes," has been worked out satisfactorily at the Altoona roundhouses. They have in the dumping pits a track which carries an iron car capable of holding the cinders dumped from the firebox of any locomotive. The fire is dumped into this car. When the engine is moved off the pit, a man attaches the chain of an air hoist to the car, raises it up, and traverses it laterally over a car on the side-track and deposits the contents therein. The work is done quickly and at very small expense. There is no depressing of track necessary for the cars that have to be loaded with the ashes, and there is no delay in cleaning fires, because the pit is full of ashes. The cleaning of fires and disposing of ashes is done by piece-work, and this improved arrangement has cut the cost in two. The men who are doing the work make better pay than they secured when doing the work by shoveling, and they find the new method much more agreeable than the old one.

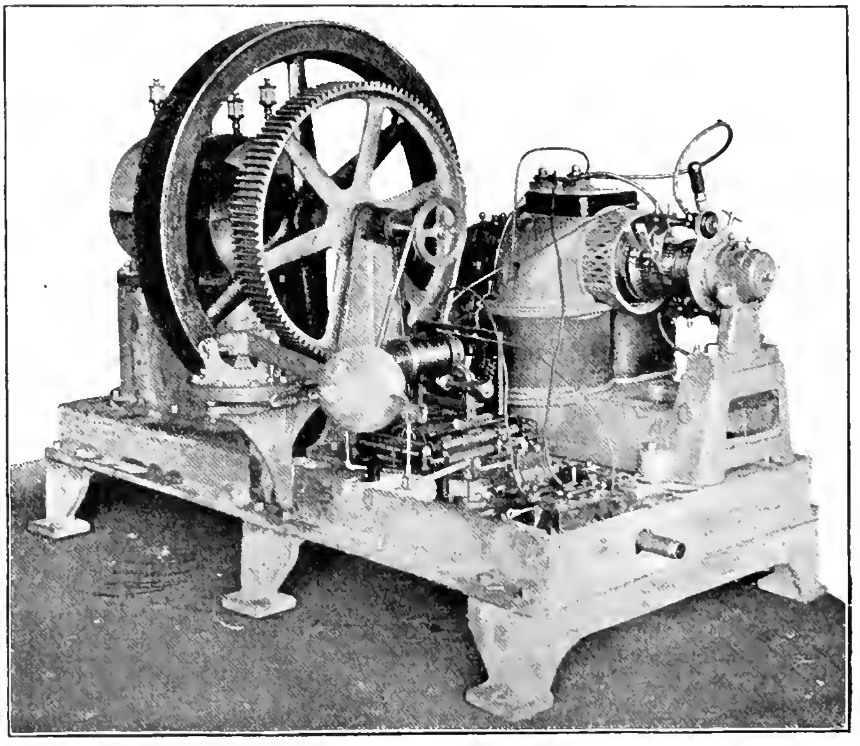
A. S.

The Canadian Pacific R.R. Co. have adopted Norton "Sun" drop track jacks and ball-bearing screw jacks as standard on their lines.

Pedrick & Ayer's Automatic Air Compressor.

We illustrate herewith one of the No. 1 automatic compound belt air compressors, made by the Pedrick & Ayer Co., of Philadelphia, arranged to be driven by an electric motor, for the Wells-French Co., of Chicago, Ill.

This arrangement retains for the machine all the automatic features, starting and stopping the compressor by the varying of the air pressure. This arrangement is accomplished by attaching the belt-shifter device to a knife-edge switch; that being connected with an electrical starter, which turns the current on and starts the motor slowly, gradually throwing off the resistance, until the desired speed is obtained. The current is thrown off automatically when the supply of air in the reservoir is reached.



By this arrangement it is possible to use this compressor in places where there is no other power than electricity, and the machine yet retain all the advantages claimed for it—that is, no more power being used than is actually necessary to keep up the supply of air, etc.

The employés of the Tyler Tube & Pipe Co., Washington, Pa., have formed a relief association where, by the payment of a small amount weekly, benefits are paid for sickness, sickness in the family, death of wife or children or of the subscriber. Shopmen who wish to organize a similar association should get the rules and regulations formulated by the men at Washington—they seem to have covered the ground completely.

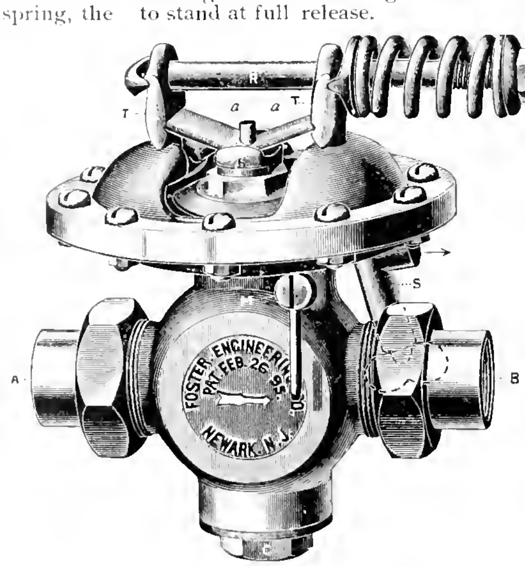
An Improved Air-Brake Pump Governor.

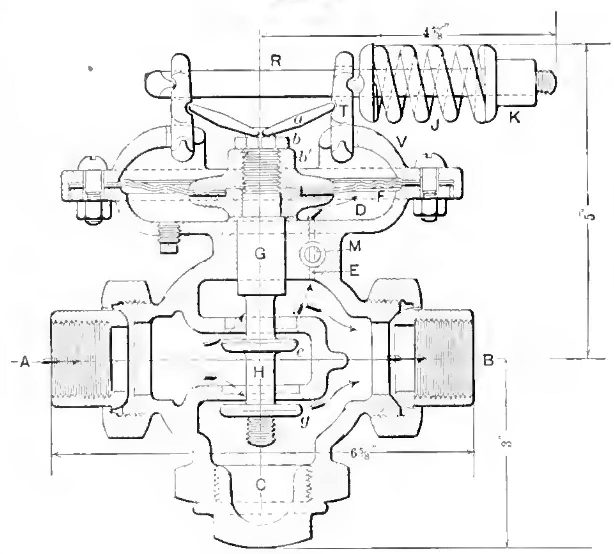
In the operation of governors now in use, the air pressure bearing on a diaphragm against a compression spring opens a small auxiliary valve when the maximum air pressure is reached, and admits air to a piston connected with the steam valve and closes it. When the air pressure bearing on the diaphragm is reduced below the power of the spring, the spring closes the auxiliary valve and allows the steam valve to open.

The Foster air-brake pump governor is constructed and operates upon an entirely different principle, the following description being furnished by its makers: The movement of the steam valve in the Foster governor is controlled by the pressure of steam in the steam cylinder of the pump. It is applied to the steam pipe leading to the pump, and has no pipe connection with the air. The steam-regulating valve is automatically controlled by the steam in the cylinder, balanced by the air in the pump cylinder. Assuming, for the purpose of illustration, that it requires 90 pounds of steam to give 90 pounds of air, the tension of the spring *J* is so adjusted that any increase above 90 pounds of steam in chamber *D* will raise the diaphragm and close the double-seated valve *H* of the governor, thus shutting off steam to the pump.

With this explanation, the operation will be readily seen. Steam is turned on at the throttle, allowing the full boiler pressure to enter the governor inlet *A*. The reduced steam pressure, passing through port *E*, enters the diaphragm chamber *D*, and, by raising diaphragm, tends to close the valve *H* to a degree governed by the power of the spring. The pump continues to work, slowly decreasing its speed as the air pressure approaches the maximum. When 90 pounds of air is reached, it balances the 90 pounds of steam, and if there was no leak of air, the pump would stop. If the steam in the pump condenses and loses its pressure, the spring overcomes the reduced pressure in the diaphragm chamber, opens the valve *H*, and instantly restores the pressure in the steam cylinder. If the air pressure is reduced, the steam in the pump cylinder overcomes the reduced air pressure, and at once starts the pump, keeping it moving until the equilibrium is again restored. In practice it is found that the pump never stops completely, although the motion will sometimes be so slow as to be hardly perceptible. It will thus be seen that, as a result of this construction and plan of operation, the pump can never "freeze up," the brakes can be set and allowed to remain indefinitely without danger of increasing the air pressure beyond the maximum, and the possibility of the pump "racing" is practically precluded.

With the Foster governor, under no circumstances can the air pressure exceed that at which the governor is set, and it is not possible to overcharge the auxiliary reservoirs except through carelessness of the engineer in allowing the brake valve to stand at full release.





The simplicity of this device is apparent from the illustration, and will commend it to all who are familiar with valves now in use. There is nothing in its construction that is liable to get out of order. To provide for a possible break of the diaphragm the port screw *M* is introduced, which, in the event of accident, may be closed, thus shutting off all but a minute volume of steam from the diaphragm chamber, and throwing the valve out of service without shutting off steam to the pump.

This new air-brake pump governor is manufactured by the Foster Engineering Company, of Newark, N. J., who offer to send it for trial in actual service to any railroad official.

WANTED—With a reliable and progressive house catering to the R.R. trade, a position by a steady and sober young man who has traveled and sold goods to other trade, and also has a general and practical knowledge of mechanics and possesses executive ability to handle men and work to best advantage. Best of references. Address "H." care LOCOMOTIVE ENGINEERING, 256 Broadway, New York.

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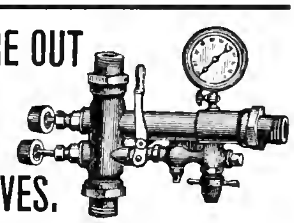

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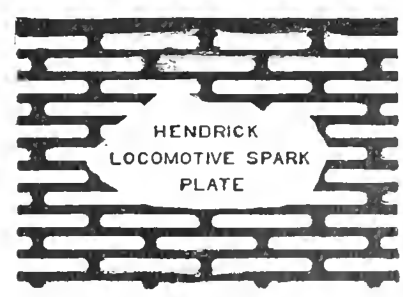

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WHAT YOU WANT TO KNOW.

Questions and Answers.

(129) J. F. N., Cohoes, N. Y., asks a number of questions that do not relate to railroad subjects. They are not suitable for our columns.

(130) A. W. L., Syracuse, N. Y., asks:

Are the New York elevated engines direct or indirect motion, and why? *A.*—Indirect, because the valve is operated by a rocker and moves in an opposite direction to the movement of the eccentric.

(131) M. R. B., Smartsburg, Ind., asks:

What is the idea or use of the small dome next to cab on mogul freighter for the Fitchburg road? *A.*—This is not properly a dome, but a casing around the safety valves, which are located directly on the boiler.

(132) J. W., Escanaba, Mich., writes:

Please give a simple method of etching to discover flaws in iron or other metals. *A.*—For iron and steel 9 parts water, 3 parts sulphuric acid and 1 part hydrochloric acid does very well. The method followed is described on page 371 of our June issue.

(133) C. M. B., Buffalo, N. Y., asks:

What are the principal resistances to the running of trains at high velocities? Is it friction of the machinery, track resistance or the air that presents the greatest obstacle to higher train speed? *A.*—The principal resistance to high-speed trains is the atmosphere. It is much greater than all the other resisting forces.

(134) C. & A., St. Louis, Mo., asks:

1. Which side of an engine leads? *A.*—When the right crosshead is on forward center, and the left pin above the center, it is a right-hand lead engine; if the left pin is below the center it is a left-hand lead engine. 2. How do you tell the "back-up" and "go-ahead" eccentrics? *A.*—The go-ahead eccentric is usually connected to the top of the link.

(135) B. S., Joliet, Ill., writes:

We have been having a little discussion about boiler feeding. One side—the big one, too—says that the man who can set his injector so that it never needs to be touched going over a division is the best kind of a runner. The other side says that a boiler should be fed just the quantity of water needed for the steam being used. We have agreed to stand by your decision. *A.*—We consider the plan of feeding water at the rate it is being evaporated to be the right way.

(136) Joe A., Temple, Tex., writes:

Suppose you were running a mogul engine, not long out of shop, and all her machinery fitted snug, and you broke a link on left side and main pin on right side, how would you get engine in and not have her towed in? *A.*—We would not try, but get ready to be towed as soon as possible. Toggling up an engine to get her into the shop in this day and age is a costly practice for railroads. The fundamental rule in every breakdown should be to clear the line for other trains as quickly as possible.

(137) J. B. D., Arkansas City, Kan., asks:

What makes an air pump wear large in each end of the air cylinder and small in the middle? *A.*—The pressure in the air cylinder is greatest at the end of the stroke. It is only atmospheric pressure at the beginning, but gradually increases throughout the stroke until it finishes at same pressure as contained in the main reservoir. In consequence, the packing rings are set out tighter against the walls of the cylinder at the ends of the stroke, and the wear on the parts there is greater. The middle of the cylinder has comparatively little wear, as the friction of packing rings there is less.

(138) C. H., Fitchburg, Mass., writes:

1. In June issue of LOCOMOTIVE ENGINEERING, "Answers to Traveling Engineer's Questions," written by Mr. M. M. Meehan, I notice in answer to Question No. 23 the words "engine gone." Will you please explain what it means? *A.*—This is a typographical error in misplacing the semi-colon. Take that out after the word nozzle and the answer is correct. 2. In answer to Question No. 35, in case of a broken eccentric or strap, it says, "Take off link." Will you please explain why link should be taken off? I claim there is no necessity in taking link off in case of a broken eccentric or strap. *A.*—It is not necessary to take down link in usual cases.

(139) A. M., Jackson, Tenn., writes:

I expect to be examined soon for promotion, and I am posting up by the help of books and by talking with men who are well posted. I find plenty of books giving points about the engine, brakes and so on, but can find nothing about train rules, except what is given in the time card. Can you name a book that will help me? *A.*—A close study of the train rules in time cards, or in the books of rules published by most railroad companies, will enable a man to answer intelligently all questions on train rules. But the best authority concerning the movement of trains is the "Standard Code of Train Rules," which will be found in our list of books.

(140) J. W., Escanaba, Mich., asks:

1. What is the use of the compression valve in the main steam valve of a Vauclain compound? *A.*—It is a relief valve, acting the same as similar valve in chest of simple engine. 2. Do the valves of this engine have lap? *A.*—Yes. 3. How can I learn to set valves with the eccentrics on forward axle? *A.*—The principle is the same as ordinary motion; use a little sense in noting what the change does with motion. 4. Which type of compound locomotive do you think is the best? *A.*—The one that does the most work with the least coal and the least repairs. 5. What is the lowest cost per car mile for operating electric street cars that you know of? The same for steam suburban cars? *A.*—We have no figures for this kind of service.

(141) W. G. B., Paducah, Ky., asks:

1. How to set eccentrics correctly while the wheels are out from under the engine. *A.*—An article describing the process appeared in LOCOMOTIVE ENGINEERING, March, 1883. 2. Best and quickest way to set valves. *A.*—The description of this process is necessarily too long for this department. It will be found in most books on the locomotive. 3. The best way to get engines to run faster. *A.*—There is no general remedy for this. We would require particulars of valve motion to answer this question properly. 4. What is best for hot driving boxes? *A.*—Graphite and good oil. 5. What lead gives best results for freight and passenger engines? *A.*—That depends on the design of valve motion. Most engines would do better work if they had no lead, especially freight engines.

(142) W. P. M., Pueblo, Col., writes:

1. What is the angularity of the main rod which I hear and read so much about?

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A.—It is the angle which the rod makes, when on top or bottom quarter, with a straight line from the center of the axle to the center of the crosshead pin. 2. What influence has it on the working of a locomotive? *A.*—As the valves of a steam engine are operated by an eccentric rigidly secured to the axle, at a certain angle from the crank, the angularity of the main rod acts to protract steam admission on one-half of the stroke and shorten it on the other. Suppose we follow the events of a stroke of the right-hand side piston, going ahead and starting from the forward center. If you measure the travel of the crosshead pin carefully, you will find that when it has reached the middle of its travel the crank pin has not reached the bottom quarter. If the valves are set to cut off at half stroke, closure will not take place until the crank pin gets to the quarter. The result is that the piston gets past the middle of its travel before the steam is cut off. When the crank pin reaches the back center, and travels on the return stroke, the crank pin will reach the top quarter before the piston has reached the middle of its travel; consequently, steam has been cut off too soon. This irregularity is remedied in link-motion engines by placing the saddle pin back of the center of the link; in stationary engines, adjustment is made by different widths of steam ports.

Notes from the Omaha Car Shops.

The C., St. P., M. & O. road has a well-earned reputation for the superlative condition of its power and rolling stock, and it is worth the time of any railroader to take a look through their shops, which, by the way, are somewhat widely separated, the headquarters of the machinery department being in St. Paul, and that of the car department in Hudson, Wis.; but the same general air of neatness that pervades both plants plainly tells of *system* in management, and convinced of that, it follows as a logical sequence that the work is turned out at a figure that slipshod shops cannot get down to, because the latter are too busy falling over oil boxes, old end sills, drawheads, etc., left just as they were dropped from the car, to monkey with anything that would cheapen the cost of the output. Mr. H. L. Preston, the M. C. B. of the "Omaha," has been bending every energy to get the equipment in shape for what is predicted the heaviest fall business in the history of the Northwest. He has built some 50,000-pound box cars that will satisfy anybody that he is in full sympathy with the importance of keeping dead weight down to the limit. They are light and strong, but we would not be true to our instincts if we did not lock horns with him on the propriety of stenciling these cars for a 60,000-pound load; they have the strength, and are carried on one of the best sets of trucks in railroad service; 4 x 8-inch axles, iron transoms, and an inside-hung brake beam of the trussed type, made of 2-inch half-round iron—the two members of the truss welded in square sections at the ends, over which passes a cast-iron sleeve carrying the brake head. This sleeve is a loose fit, and has a slight movement on the beam which allows lateral adjustment of shoe on the wheel tread.

This entire truck is a home product that in our opinion ranks with the best—all built at these Hudson shops, and at a figure that the supply manufacturers would not care to duplicate.

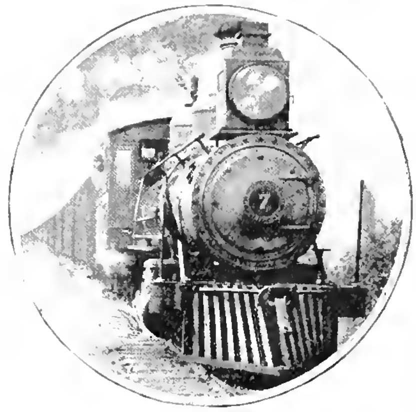
They carry their pursuit of standards even to the bending of air-brake train pipes. These pipes are bent between two oak blocks which are made to the required curvature, and this, by the way, is nothing more nor less than the "line of beauty" every draftsman or artist is taught to make. The blocks are then grooved for the pipe, and the groove is sheathed with iron to preserve its form. The pipe is laid between the blocks, and one push of the pitiless bulldozer does the rest. This scheme makes the train pipes absolutely interchangeable. Yes; the "Omaha" is paying dividends all right, and it is the result of management.

O. H. R.

A special invention, which has received a good deal of attention from mechanical men, has been the means of releasing compression in locomotive cylinders as the piston is approaching the end of the return stroke. The latest invention in this line has been patented by Mr. J. M. Keith, an American master mechanic in Guatemala. He proposes to attach two supplementary valves to the valve stem of a steam engine, one at each end of the steam chest; the valves are so arranged that when the period of compression begins, an opening is made to the atmosphere by means of a pipe pierced through the cylinder-head and connected with the underside of the supplementary valve. It appears to be a very ingenious arrangement, and we have no doubt that it will relieve the piston from the necessity for compressing the steam left in the cylinder during the return stroke.

The latest contribution to the literature of bi-metallism is entitled "Facts on Finance," and comes from the pen of M. M. Smith, a fireman on the D. & R. G. R.R. at Salida, Col. We do not pretend to be financiers nor judges of arguments on financial subjects, but must say that the subject matter in this little work shows the author to be a student and a patient grubber after facts on the subject of finance. It is written especially for workingmen. The work is issued by the author at 15 cents per copy, and is well worth the money to anyone interested.

S. N. Clarkson & Co., of Chicago, have sent out a new special price list of the leading watch movements used by railroad men.



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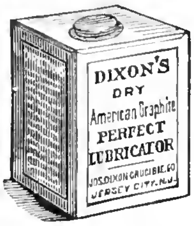

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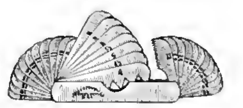

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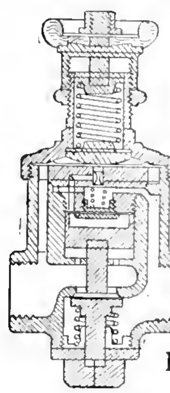

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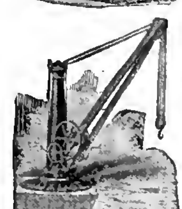

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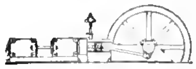

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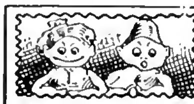

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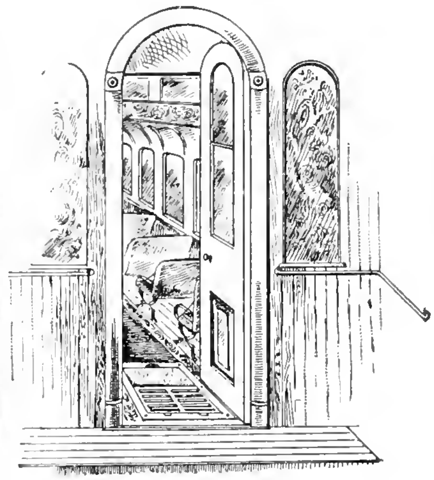

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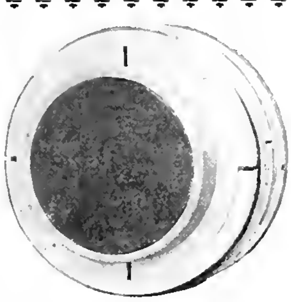

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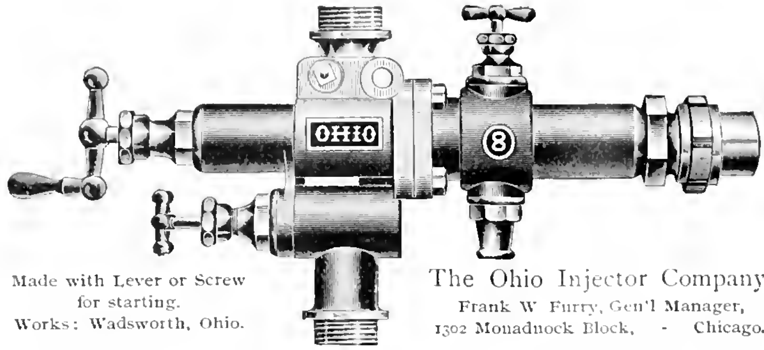

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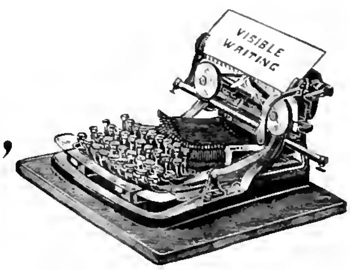

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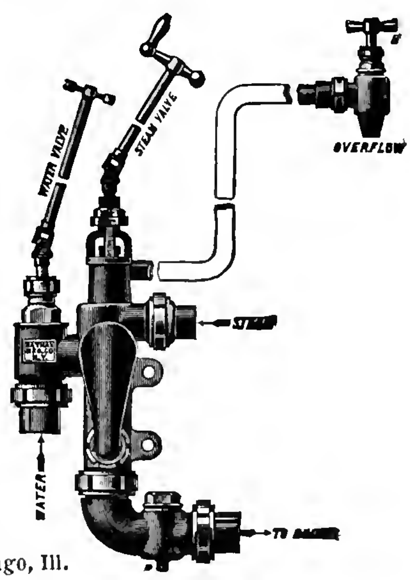

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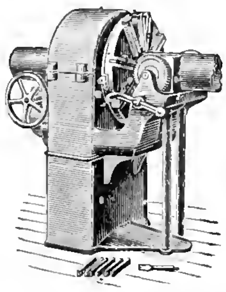

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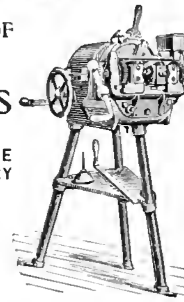

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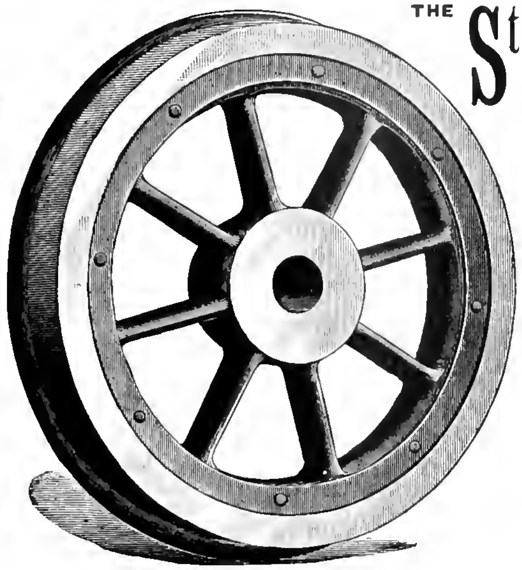

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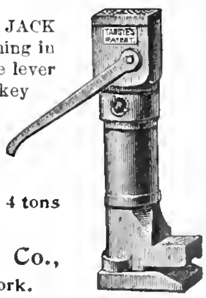

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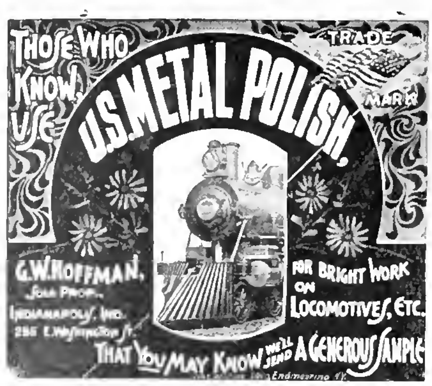

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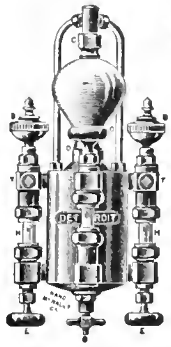

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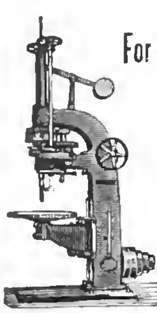

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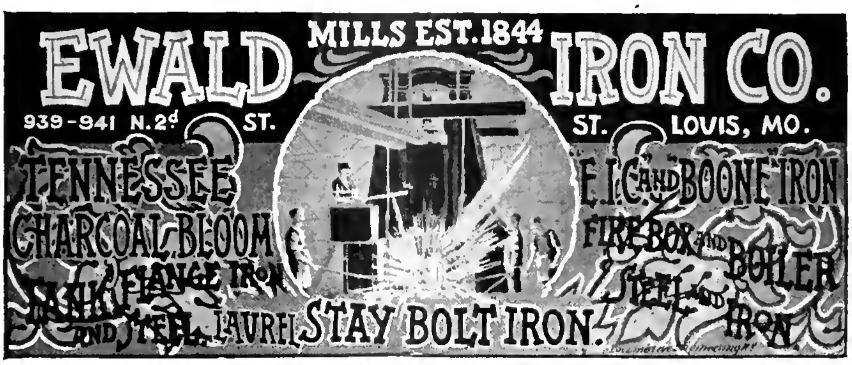

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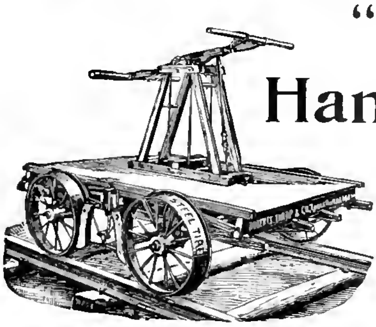

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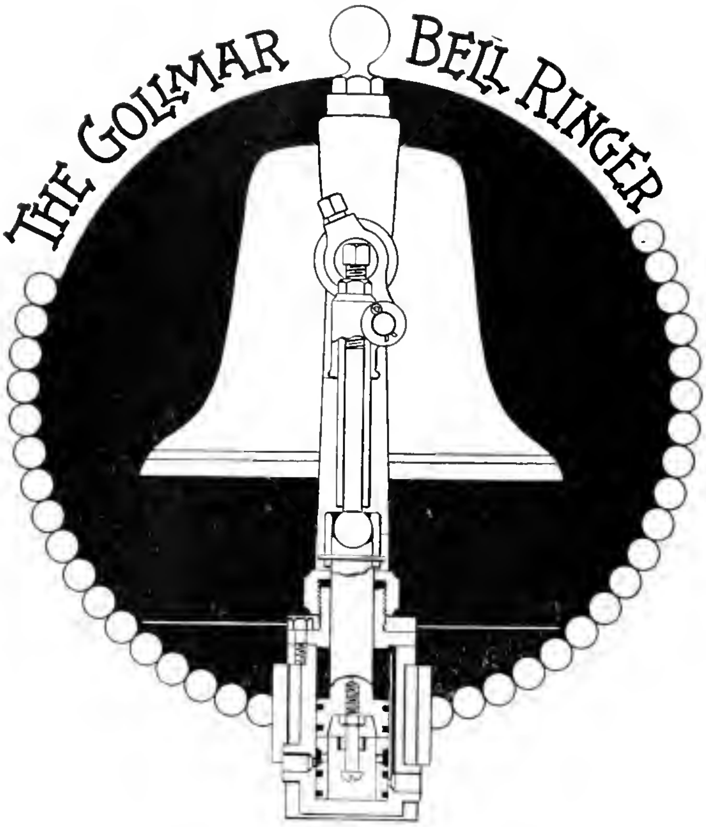

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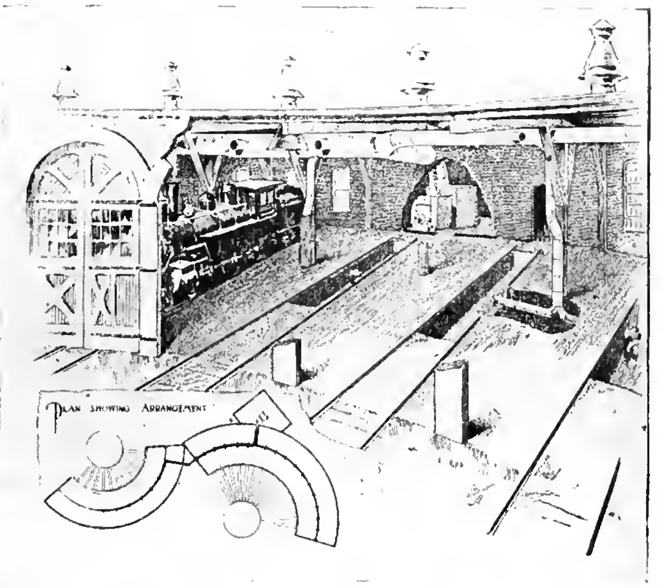

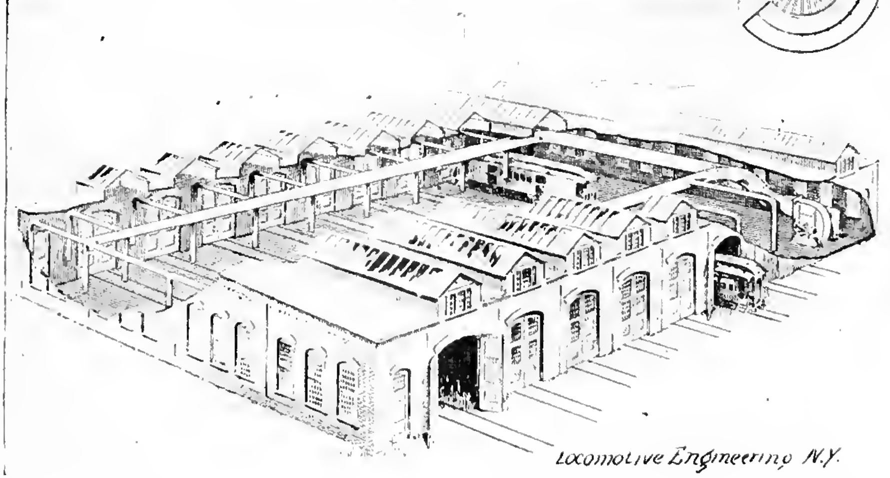

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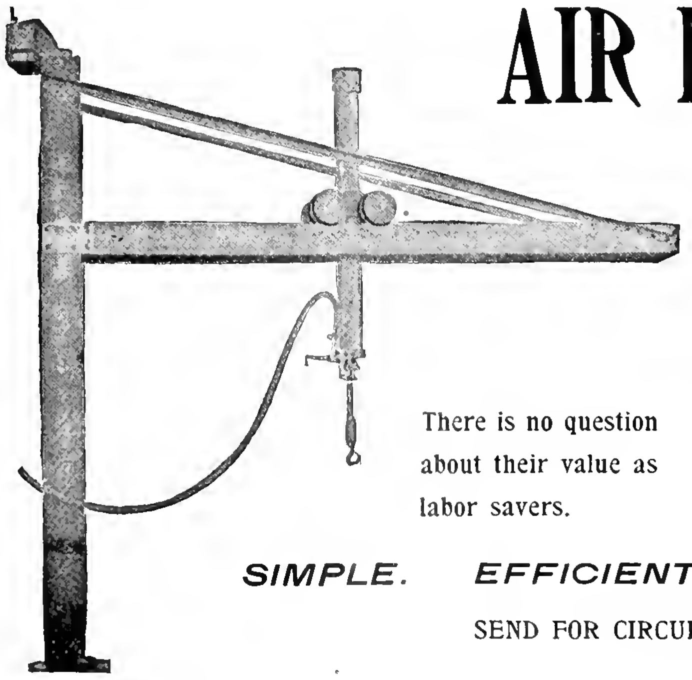

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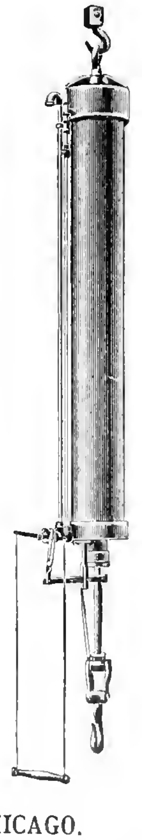

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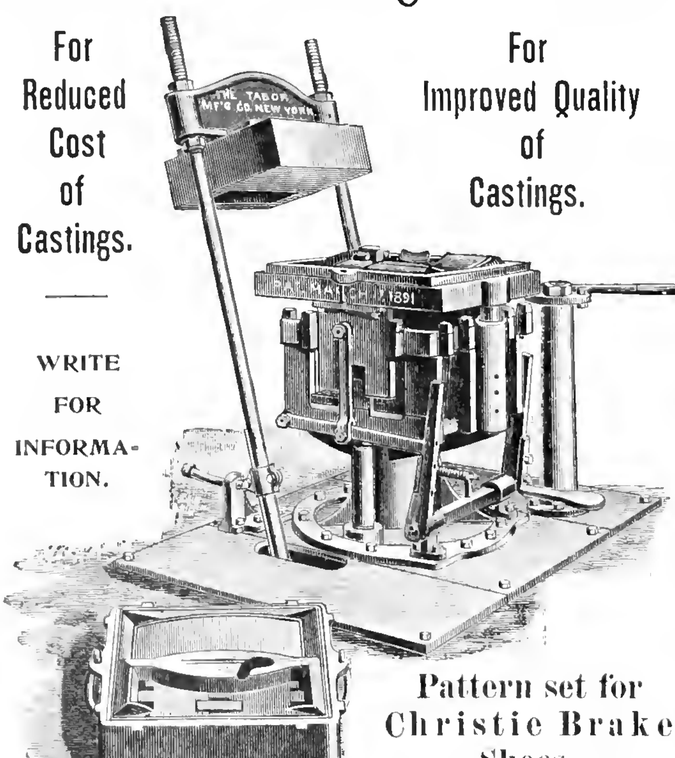

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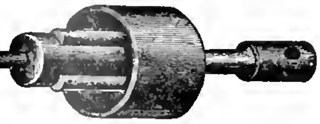

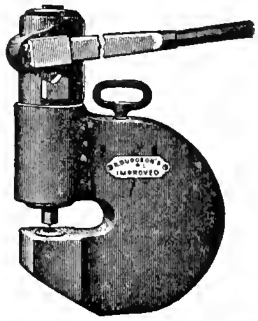

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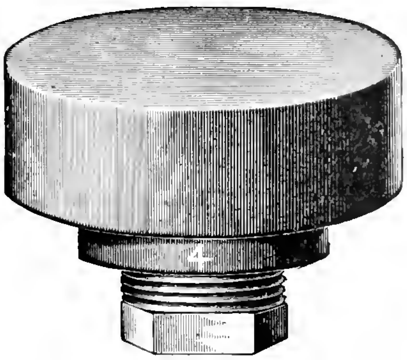

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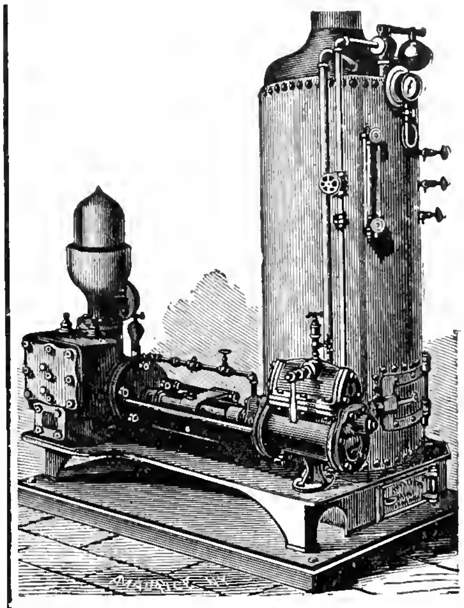

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SAFETY, SPEED and ECONOMY are the results of the use of Galena Oils. COLD TEST, 10 to 15 BELOW ZERO. These oils do not freeze in the coldest weather, while they are adaptable to the hottest climates.

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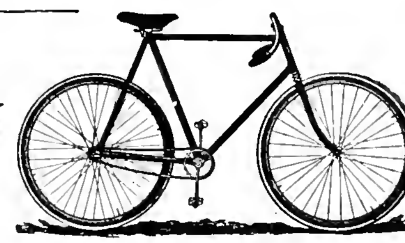

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Double Bourdon Spring and Elastic Packing Ring.

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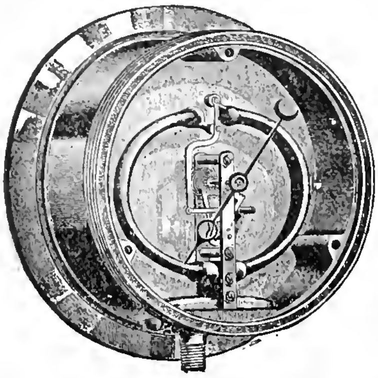

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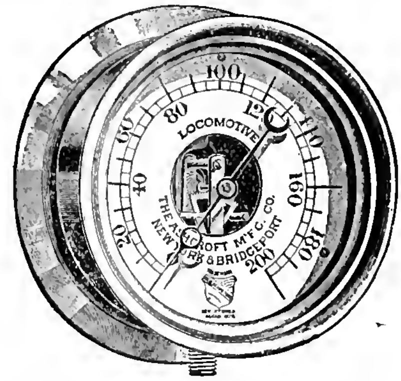

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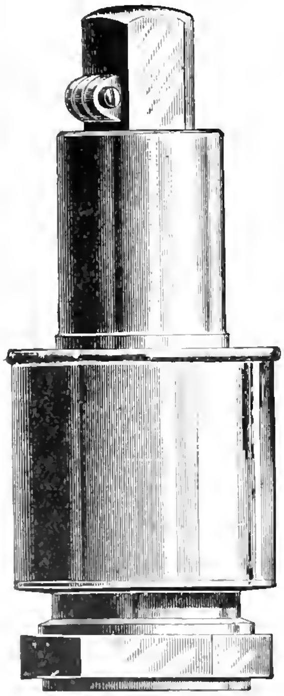

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NEAT, COMPACT, DURABLE.

RECEIVED HIGHEST AWARD AT COLUMBIAN EXPOSITION FOR DESIGN, MATERIAL, WORKMANSHIP AND FINISH.

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IS FITTED WITH THIS VALVE AND MUFFLER, AND THE VALVE AND MUFFLER HAVE BEEN ADOPTED AS STANDARDS BY THE ROAD.

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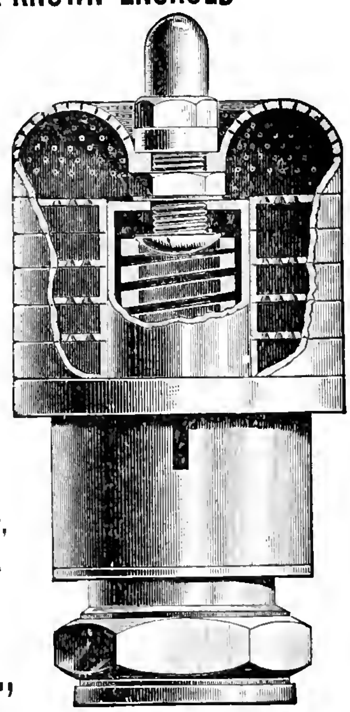

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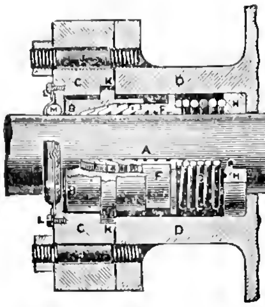

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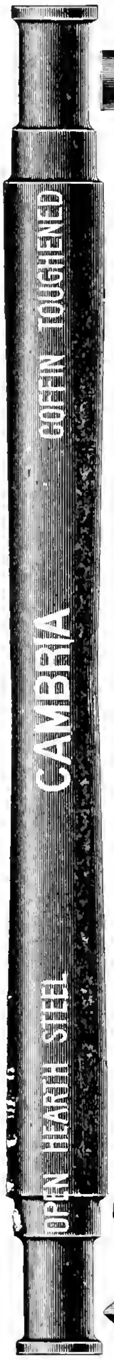

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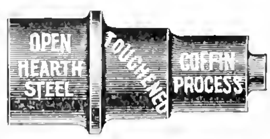

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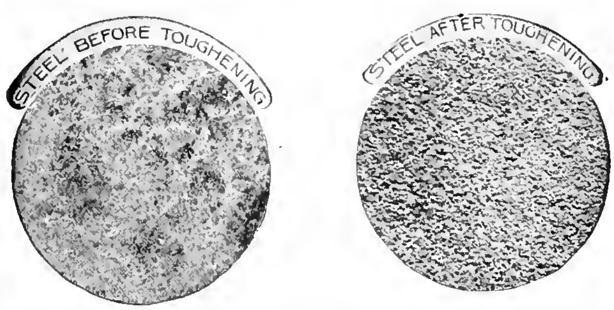

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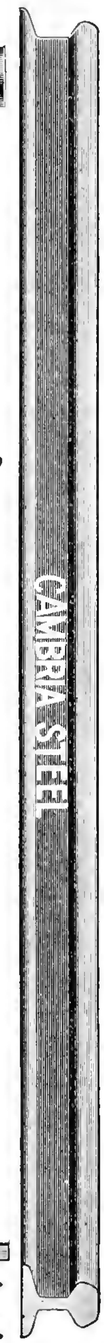

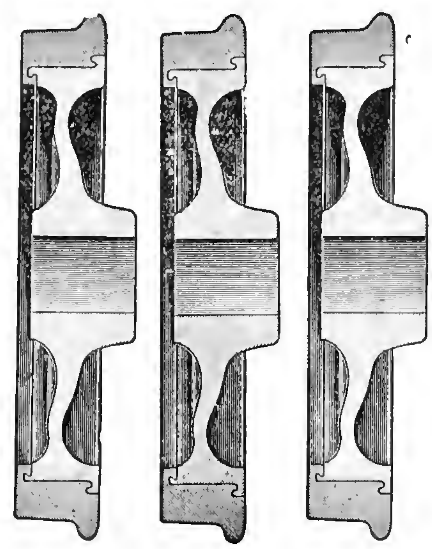

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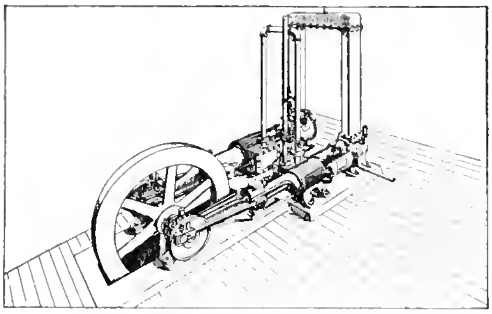

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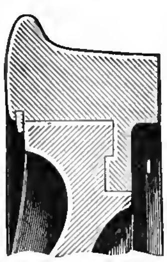

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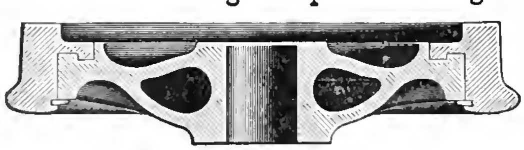

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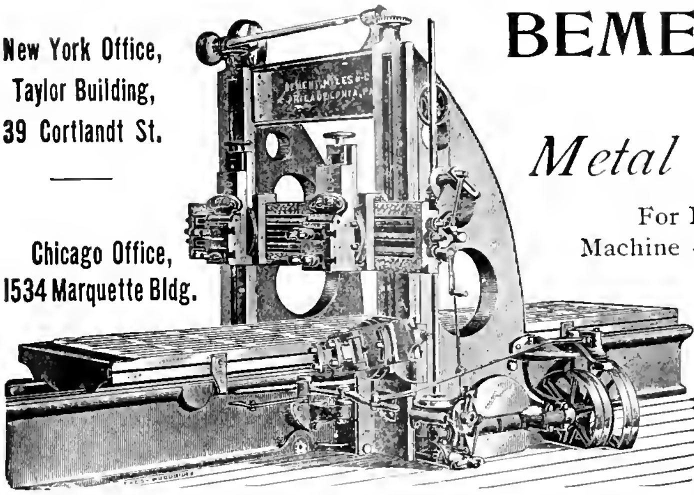

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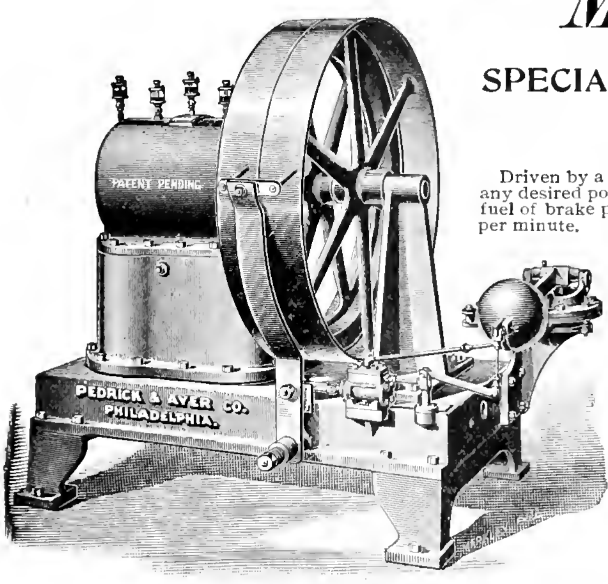

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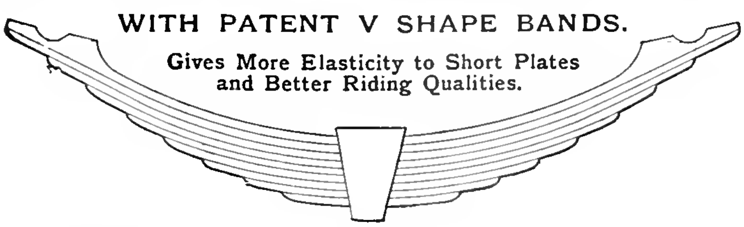

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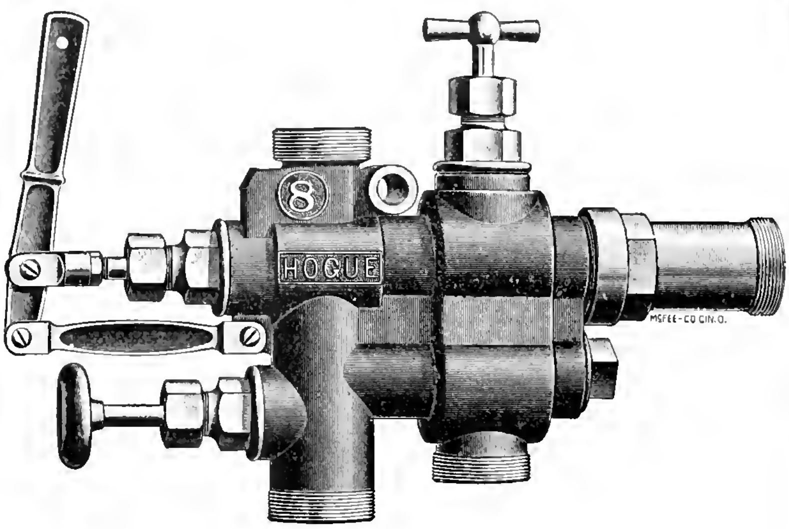

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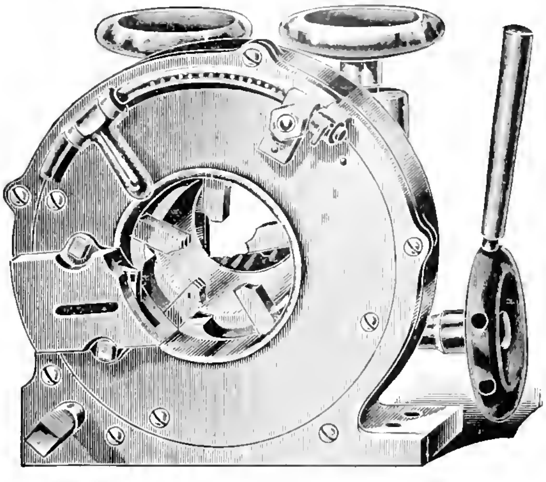

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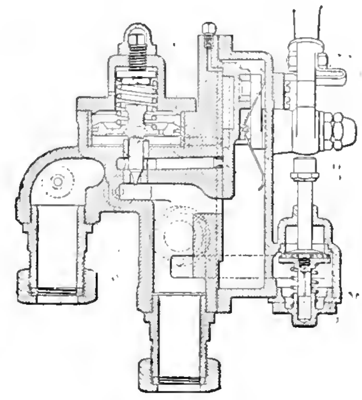

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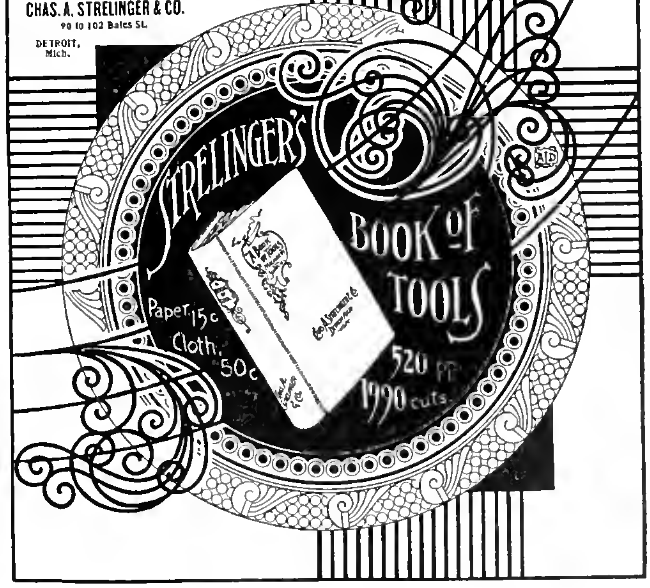

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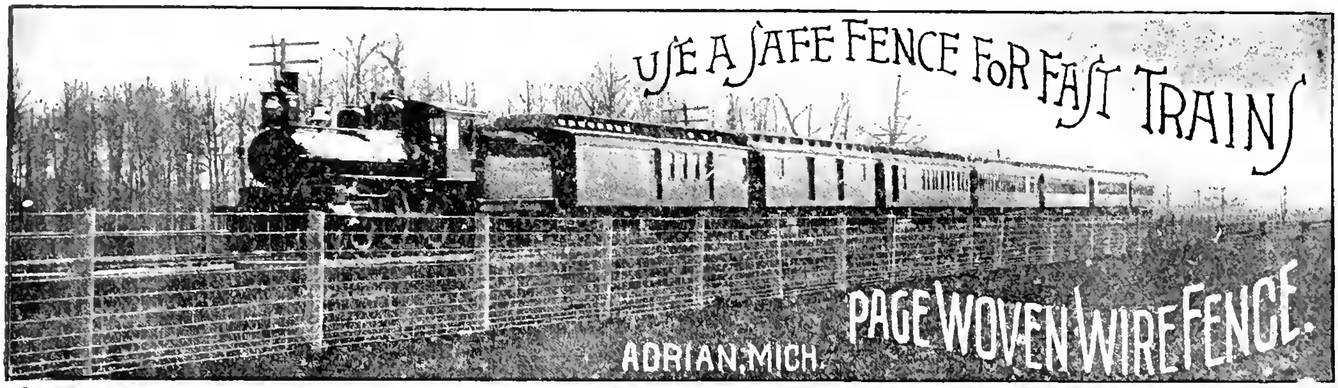

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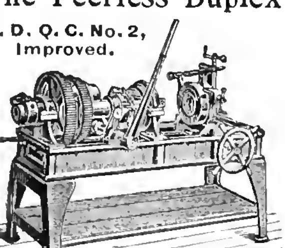

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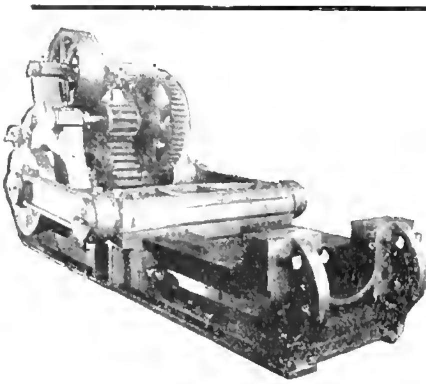

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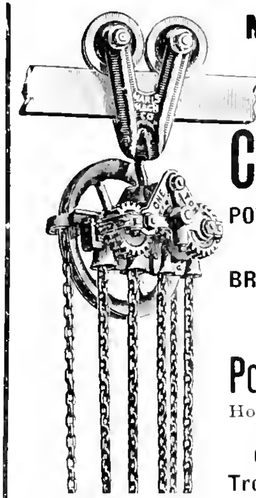

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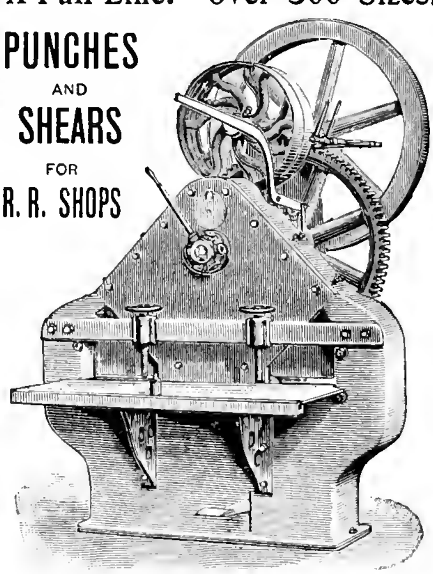

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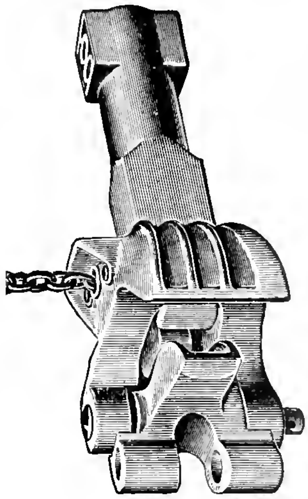

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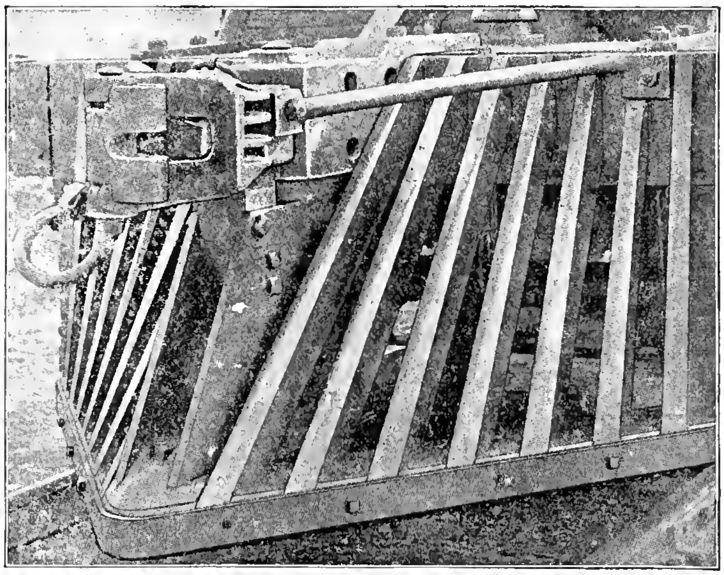

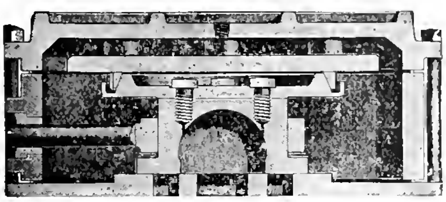

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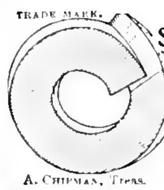

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Especially adapted for Locomotives.
Never sticks the Throttle.

The Original Ring Packing.

In ordering give EXACT diameter of Stuffing Box and Valve Stem.
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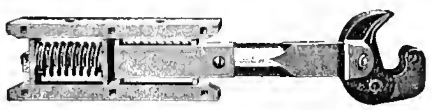

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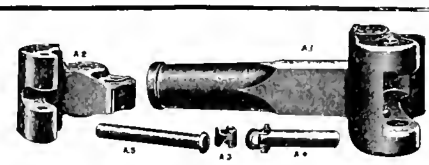

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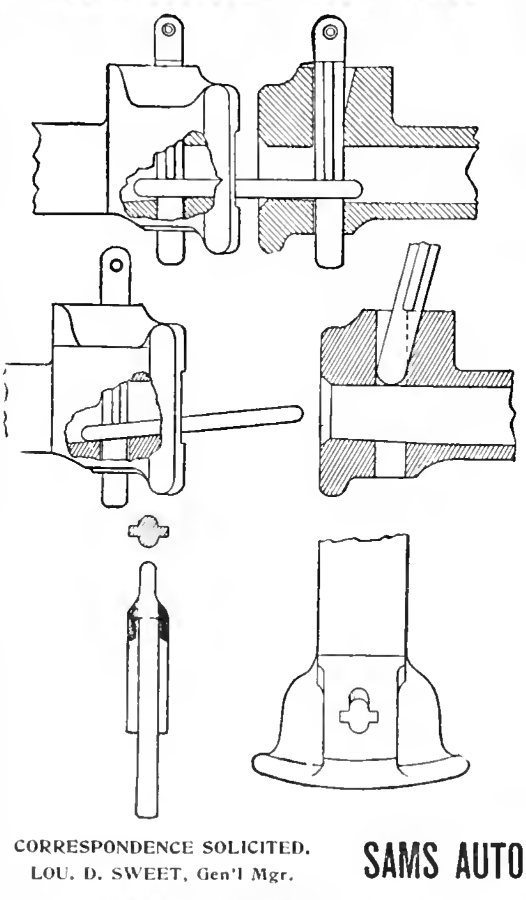

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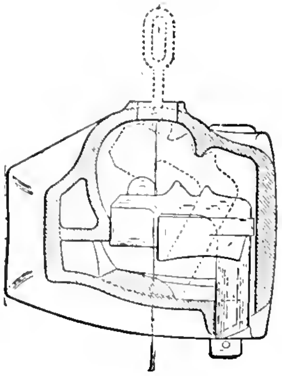

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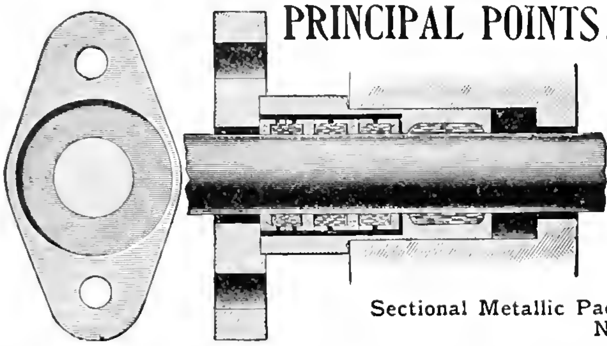

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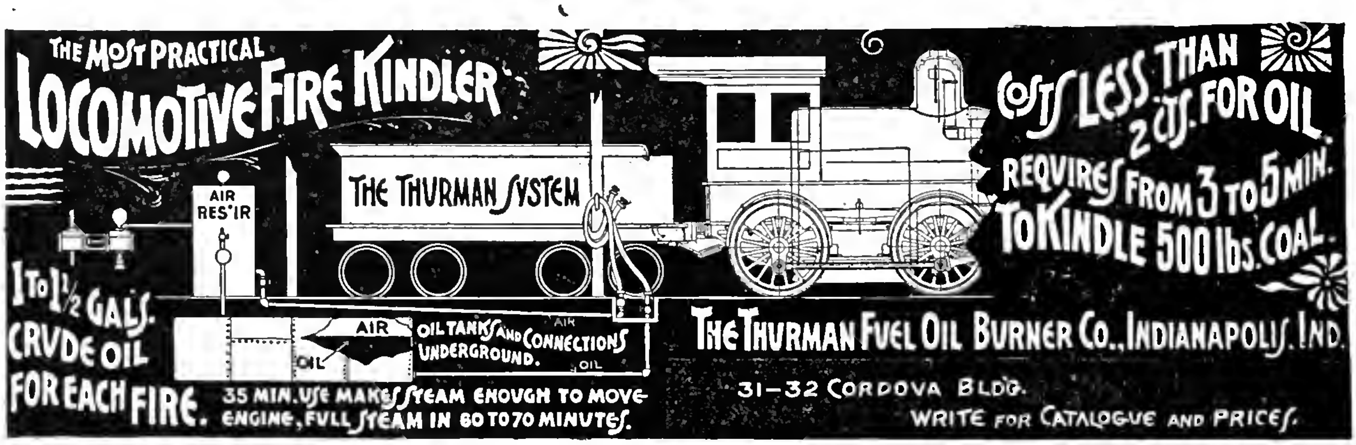

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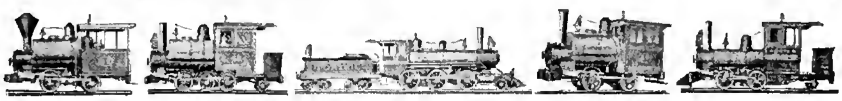

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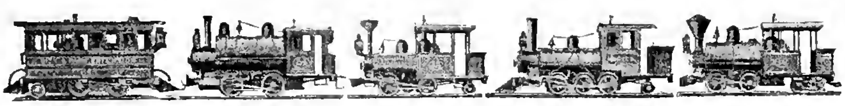

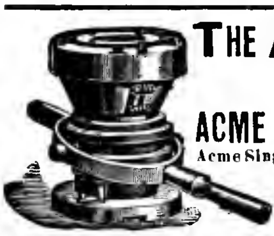

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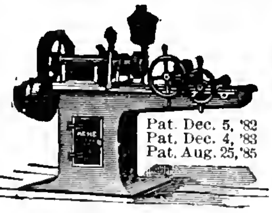

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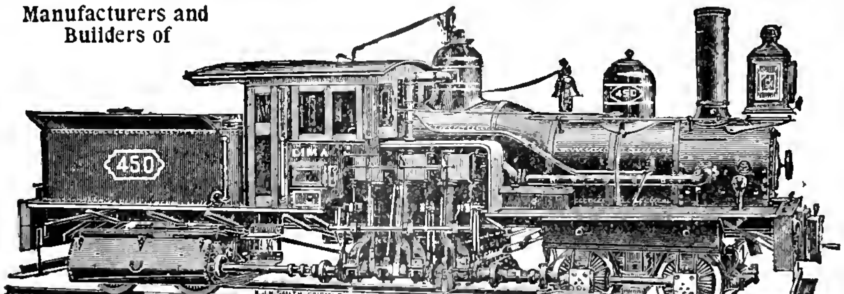

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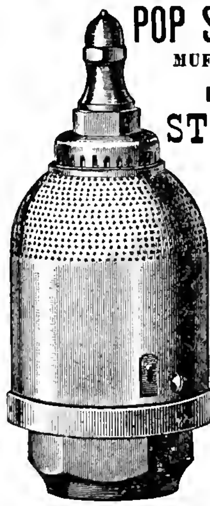

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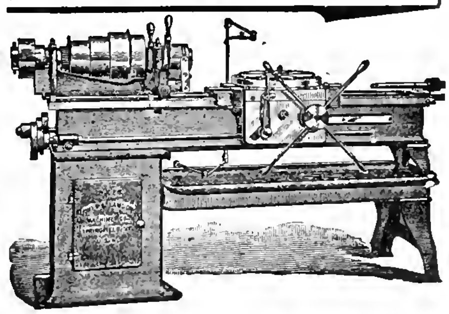

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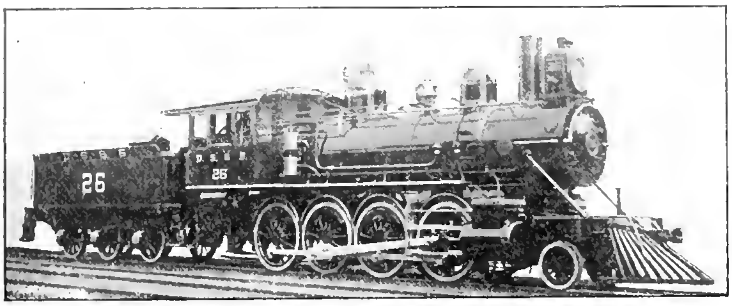

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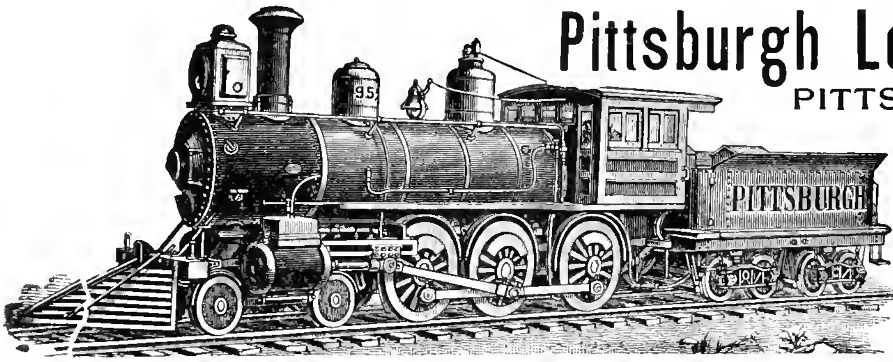

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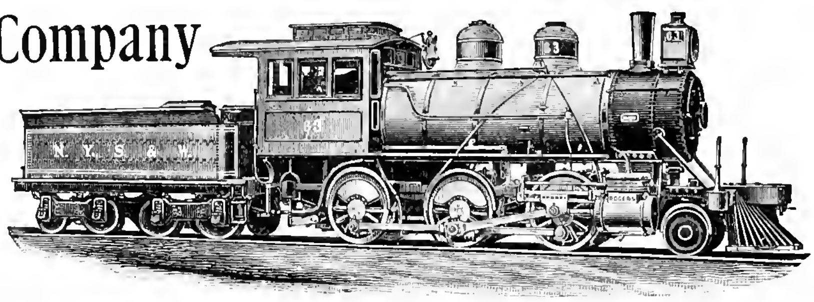

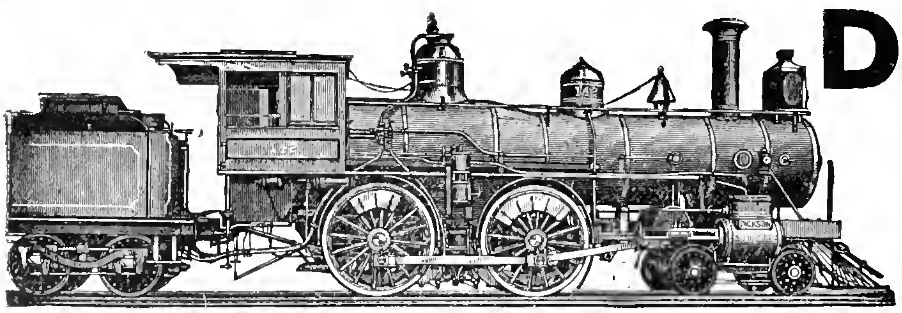

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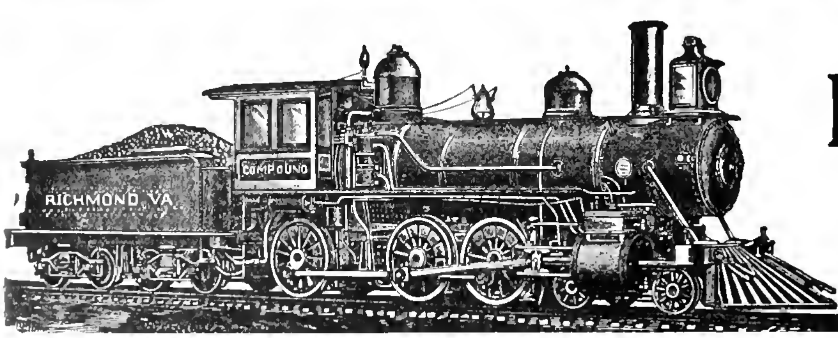

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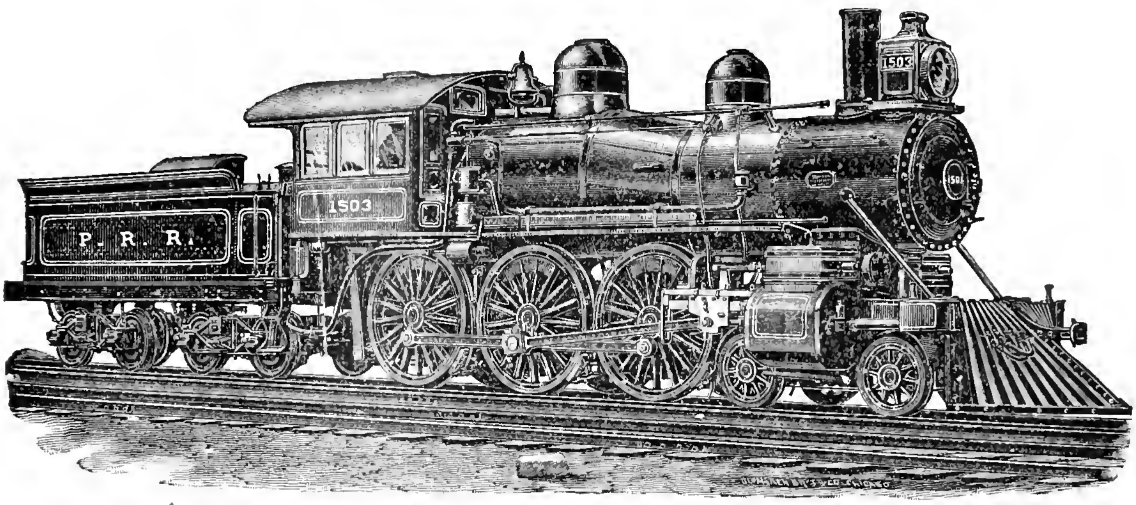

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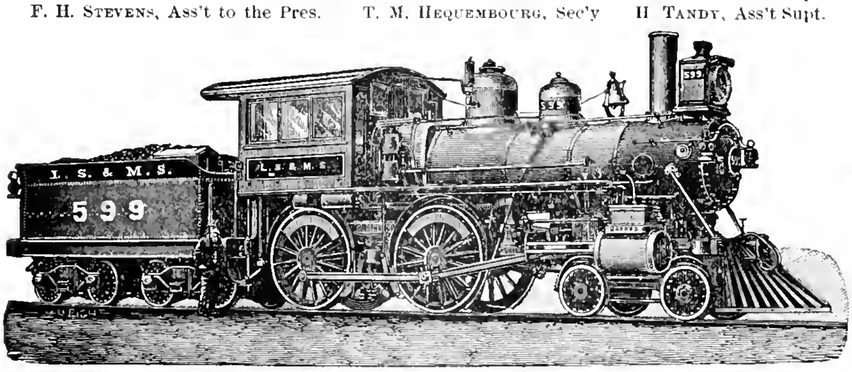

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The New Compound Moguls on the Pennsylvania.

The latest experiment of the Pennsylvania people is, we think, liable to settle a few mooted questions.

In the first place, the five locomotives, all exactly alike except the cylinders, ought, after a year or two of trial, to go a long way toward telling what kind of two-cylinder compound is the best. One of the five is a simple engine, and there is one each of the following compound systems: Von Borries (the one shown), Gold-dorf, Pittsburgh and Richmond.

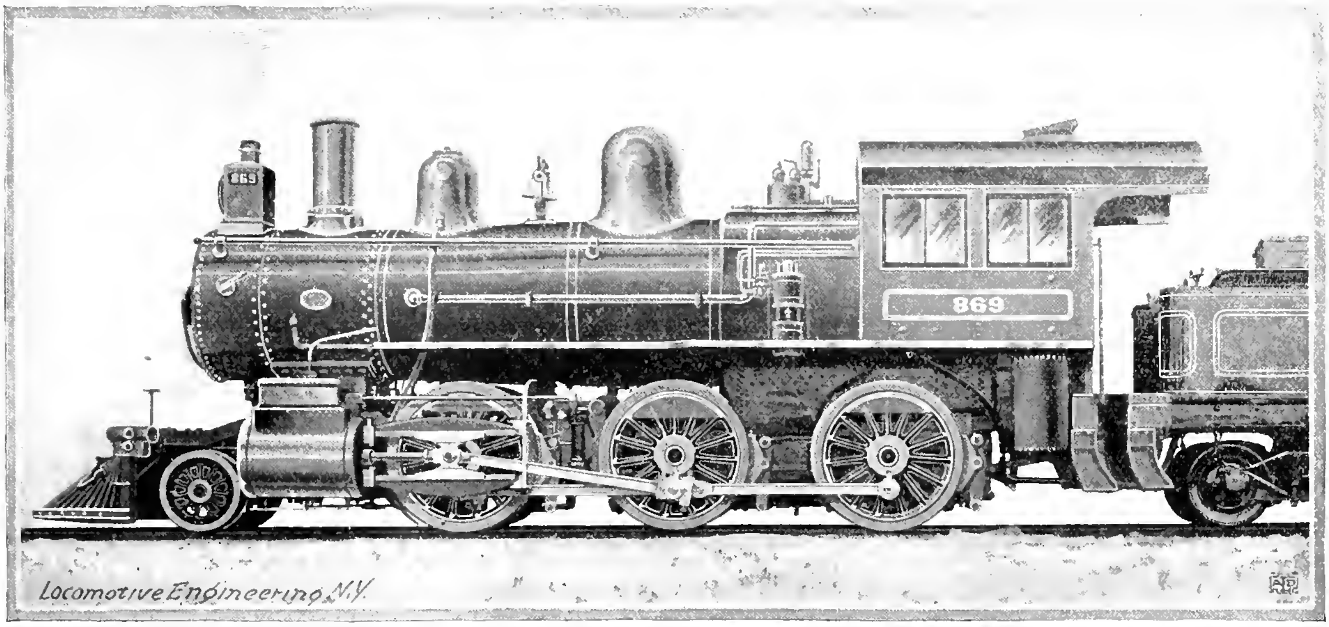
Officials of the Pennsylvania Railroad have experimented with compounds long enough to be convinced that there is something in the system, and that the two-cylinder style of compound is most likely to fulfill their requirements.

In the second place, they have had courage enough to put a big boiler over the axle of a big wheel. It is believed by some of the ablest mechanics in the business that heavy freight engines having much larger wheels and longer stroke would be more efficient and more economical for freight service, as they would ride better, have better steam distribution, wear out their machinery slower, and be capable of higher speed without uncomfortable consequences.

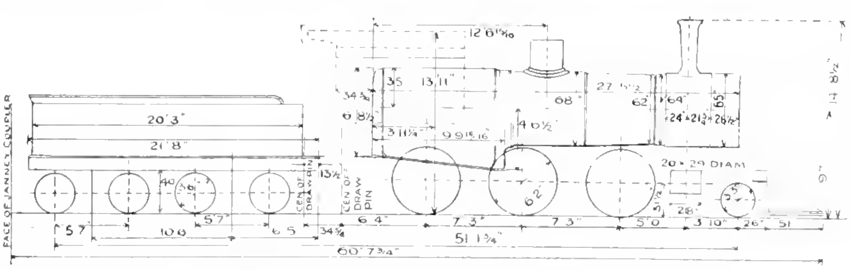
The first of the five experimental engines has been turned out of the Juniata shops of the Pennsylvania Railroad, and is shown in our engraving. This engine, "869," is the Von Borries compound, and while a very handsome engine in every way, has some ear-marks of her own. The "powers that be" at Altoona always turn out something of their own.

The most peculiar part of this locomotive is her valve motion. It can be seen on the engraving that the tumbling-shaft is just behind the rocker, and the arms reach ahead of it; the rocker shaft sets vertical, the lower arm working through a slot in the box casting and reaching inside the frame, while the top rocker extends out, as shown.

We have made a plan sketch from memory, and not to scale at all, of the internal economy of this arrangement. The regulation eccentrics and link are employed, the link block is pivoted to the end of a long, square block, sliding in a box or guide ahead of the link; this block transmits motion to the vertical rocker through the short, crooked, transmission bar shown, this bar is supported on a pad of cast iron with lubricating arrangements on it. This device may have its good and bad points, but just now its only advantage seems to consist in being different.



COMPOUND MOGUL FAST FREIGHT LOCOMOTIVE, PENNSYLVANIA R.R., BUILT AT ALTOONA, PA.



Our outline sketch gives most of the principal sizes, the other dimensions, weights, etc., are as follows:

Gage of track, 4 ft 9 in.

Cylinders, diameters, 20 x 29 in., stroke, 28 in.

Spread of cylinders, 86 in.

Diameter of drivers, 62 in.

Total wheel-base of engine, 23 ft. 4 in.

Total wheel-base of engine and tender, 51 ft. 1¾ in.

Width between centers of frames, 42 in.

Width of cab, 9 ft. 7 in.

Height from rail, 14 ft. 8½ in.

Boiler 62 in. diameter at smallest ring, 68 in. at dome sheet, Belpaire.

Firebox, 9 ft. long.

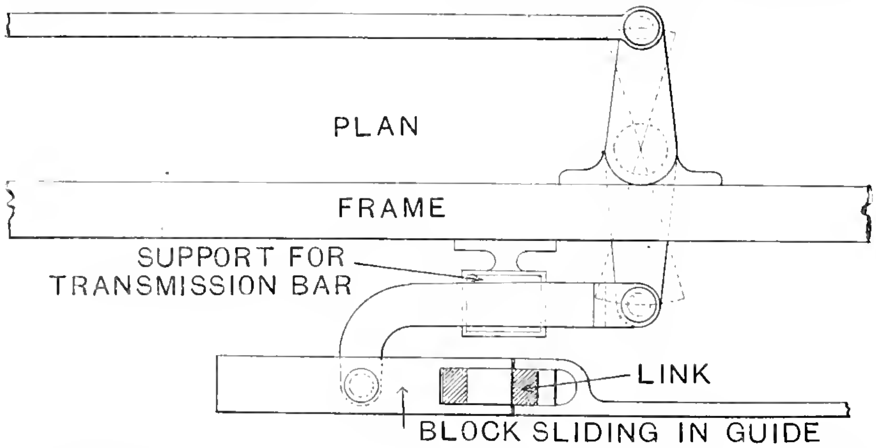
Firebox, 3 ft. 4 in. wide.

279 2-in. tubes, 11 ft. 8¹¹⁄₁₆ in. between tube sheets.

Weight of engine, 138,000 lbs.; 18,000 on the pony truck and 40,000 on each pair of drivers.

The tender holds 3,600 gallons of water, and is fitted with a water scoop to save delays on fast freight runs.

The engine has outside-equalized driver brakes of the "pull" pattern.



The guides are of cast iron, with heavy stiffening ribs, as shown.

The jacket is steel, painted black. The arrangements in the cab are handier than some engines turned out by the Pennsylvania Railroad, and not far different from the '95 "P.'s," or what is now known as the class "L."

While this engine has been out of the shops for about a month she has not yet (October 25th) been put to regular work; she developed eccentricities that had to be first overcome, although they were all of a minor nature and easily taken care of.

We are inclined to think that the 62-inch wheel and the 28-inch stroke will be found to be a first-class combination, and that this mogul will be found as efficient as the average consolidation engine, much better proportioned, easier repaired, inspected and cleaned.

Railroad men far and near will be interested in this trial of the various two-cylinder systems of compounding, and the results will be worth something to the railroad world. We have our doubts if any one of the compounds will be adopted by the Pennsylvania Railroad. They are not much given to handling anything but goods of their own brand, and it is likely in the end that they will adopt a compound of their own. It is almost the only road in America where the motive power is almost entirely of their own design and build, and there are some mighty fine-looking and fine-working engines on the road—power that any road might well be proud of.

Locomotive Boiler Lagging.

At the last meeting of the Southern & Southwestern Railroad Club, a paper on "Locomotive Boiler Lagging" was read by Mr. R. P. C. Sanderson, division superintendent of motive power of the Norfolk & Western Railroad. He detailed at some length the familiar troubles due to wooden lagging. The increase in steam pressure has greatly intensified the tendency to set fire to wooden lagging, and nearly every railroad company is trying to find a satisfactory substitute. They tried a lining of asbestos board under the wooden lagging, but it did little good, as the asbestos is not a good non-conductor of heat. "We also tried," continued the author, "several plasters and cements on the boilers with a view of doing away with the combustible goods altogether, but these plasters and cements on boilers are objectionable in that external leaks cannot readily be detected. Inspection of the exterior of a boiler, which inspection is very necessary where high pressures are used, is almost an impossibility unless the whole of the plaster is removed, which would be a source of expense. Some of these plasters, too, become disintegrated with long service, settling in the bottom of the jacket in the shape of powder, which, dusted through the joints on to the motion work of the engine, gives it the appearance of having run through a flour mill, which also was not very good for the wearing surfaces of the link-motion pins.

"I believe that with improved methods of manufacture, it will eventually be found expedient to use some kind of incombustible sectional covering for boilers carrying high-pressure steam, which can be fitted to the boiler when it is originally built, and which will be so durable that it can be taken down and put up as often as may be necessary during the life of the boiler without injury to itself. In view of the greater care that is now being taken in railroad shops in the matter of inspection of stay-bolts, and the extended use of hollow stay-bolts, some arrangement of lagging is very desirable which will permit of the examination of the ends of the hollow stays without having to take down any portion of the lagging or require other expenditure of labor to make this inspection. I am sorry to say that nothing in this line which might be considered satisfactory has yet come to my notice, although I hope some makers will soon produce something that will fill this want."

Cast-Steel Driving Wheel Centers.

The Baldwin Locomotive Works placed an order last month with the Penn Steel Castings & Machine Co., of Chester, Pa., for 280 cast-steel driving wheel centers. This is a line of improvement that is making rapid progress in locomotive construction, the Schenectady people and several other locomotive builders having ordered a considerable number of cast-steel driving wheel centers since the year began.

We have always been surprised that American railroad companies adhered so persistently to cast-iron driving wheel centers, for they have to be made enormously heavy to give the strength necessary for the power transmitted in modern locomotives. The ends of rails must be badly damaged by the heavy wheels hammering them with no spring intervening to soften the blow. Pouring excess of metal into driving wheel centers is placing superfluous weight in the wrong place. Designers of locomotives frequently meet with embarrassing problems owing to restrictions of weight that will be safe for bridges, and it is a common thing to sacrifice the weight of boiler to get within the necessary limits. This means a boiler too small for the cylinders. With well-designed wheel centers, 300 pounds per wheel can be saved by the use of cast-steel centers when the latter are about 5½ feet diameter. This weight put into the boiler will make a much more efficient engine. Steel centers cost so little more than cast iron that every railroad in the country ought to adopt the stronger material.

Discipline without punishment—the only decent way to deal with railroad employés—is gaining ground every day. General Superintendent Brown, of the Fall Brook road, who instituted a feasible plan and made it a success for twelve years before describing it in LOCOMOTIVE ENGINEERING, is being consulted all the time by one railroad official after another who are taking the matter up. A little common decency goes a long way toward making men careful—thirty-day suspensions make them hungry, and a hungry man is vengeful if he knows who took his bread—and they usually know.

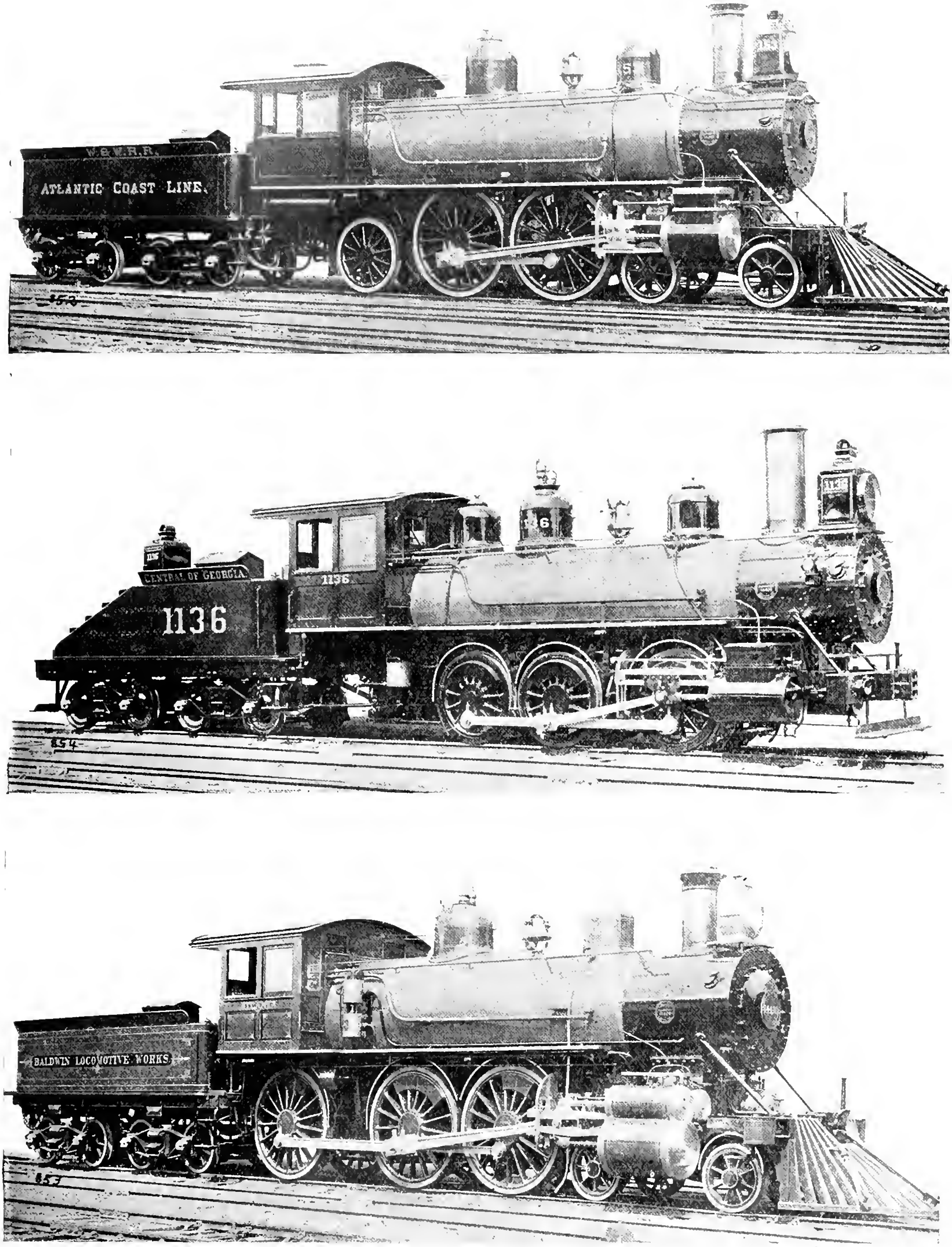


EXHIBIT OF THE BALDWIN LOCOMOTIVE WORKS AT THE ATLANTA EXPOSITION.

A Model Tool Room.

The engravings on the opposite page are views of the tool room of the Parsons, Kansas, shop of the M., K. & T. Ry. system.

The picture at the top was taken from the doorway, looking in towards rear of room.

The lower one is a view, from the rear, looking front towards the tool window and doorway.

These pictures will give a good idea of how the tools are kept, and in what system, for convenience of handling.

This tool room is equipped with an Israel H. Johnson & Co.'s 15-inch swing lathe, taking 48 inches between centers. It has a taper attachment, and is also fitted with overhead drum for grinding purposes. A Pedrick & Ayer heavy Universal milling machine, a Pratt & Whitney No. 3 small drill press, a Dwight Slate universal reamer and cutter grinder, and a Washburn polytechnic make of twist drill grinder, having a capacity from ¼ to 2-inch drills; also a wet grinder, with wheel 2 x 12 inches for quick or all-around grinding.

Most all of the tools used in this shop are made here, except such as twist drills, stay-bolt taps and machine taps, the management believing these can be bought cheaper, and at the same time get a better article from those who make these particular tools a specialty.

All other tools, such as taps, dies, reamers, etc., are made here for this shop's use, and many are also made for the use of the many other division points on the road.

As for special tools, there are very many; in fact, it would seem there was a special tool for every piece of work on or about an engine.

As will be seen, a revolving case or rack is here used for holding hand reamers, machine reamers and taps. This is placed close to tool window, so as to be convenient and within easy reach.

Tap wrenches, die plates and ratchets are kept on shelves under one end of work-bench, to the left of tool window.

Iron clamps, face-plates, stud nuts and letters and figures are kept on shelves just under window, within easy reach.

A large oil tank, with three separate compartments, sets to the right of the window and directly under tool board. This tank holds an abundant supply of oil of the different kinds issued to vise or machine hands.

A large wall rack, extending almost full length of room, gives place for twist drills, special taps and special reamers, each placed in separate divisions or receptacles to protect cutting edges.

The lower part of rack forms shelves for holding wrenches, pipe tongs, handled punches, chisels and the heavier tools of that class.

The check system is used here in letting out tools to the men. Every machinist or helper who has occasion to use any of the tools kept in this room has five or more brass checks given him. These checks are numbered, each man having a certain number. On drawing out a tool, he deposits a check, which is placed in the case or rack where tool is taken from. For such tools as wrenches, ratchets, pipe-tongs and that class, they have a tool board, where the name of those tools, as well as size or number, is painted on, and the check is hung upon that.

On returning the tools in good condition and clean, the check is returned to owner. By this system it can be seen at a glance, if the tool is not in, who has it, and no time is lost wondering who has it out or where it can be found.

Here every tool has its place, and is looked after promptly when not returned in a reasonable time.

In the way of conveniences, this tool room is furnished with a wash sink, having hot and cold water, and there are large, decent clothes lockers for the three men who work in this department.

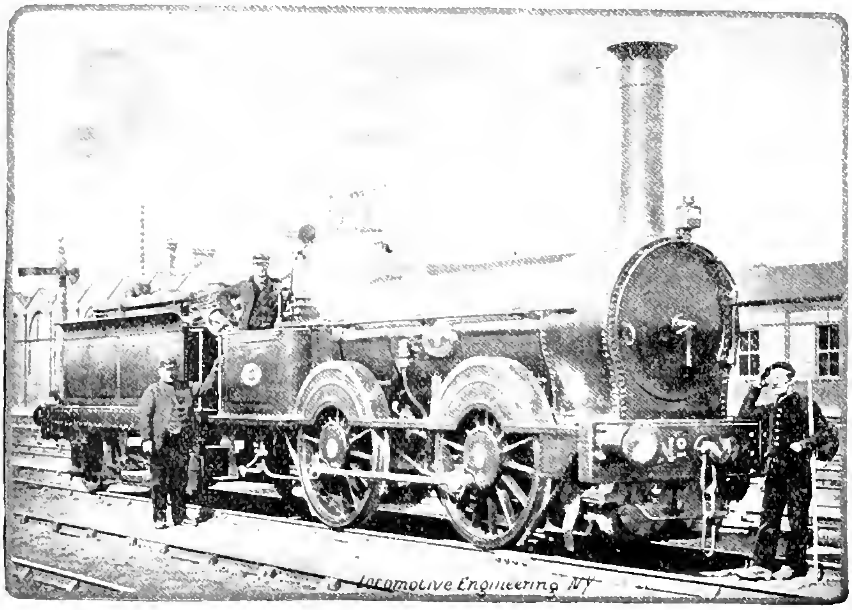
The room is piped with compressed air for cleaning tools and dusting out racks.

Plenty of light from four large windows in front of work-bench make work a pleasure here.

Large closets are arranged along wall on one end of room for holding spare tools or stock tools, which are constantly kept on hand ready to ship to outlaying shops.

This department is in charge of William J. Schubert, a young man who started to learn the trade in this shop nearly twenty years ago, and who might be said to be a product of the "Katy" system. He is to be congratulated on his nice tool room and the road in having such a man in charge.

Who has a better tool room than this?



ONE OF THE OLDEST ENGINES NOW RUNNING IN ENGLAND—ON THE FURNESS-BURY RAILWAY.

Railroads in Historic Lands.

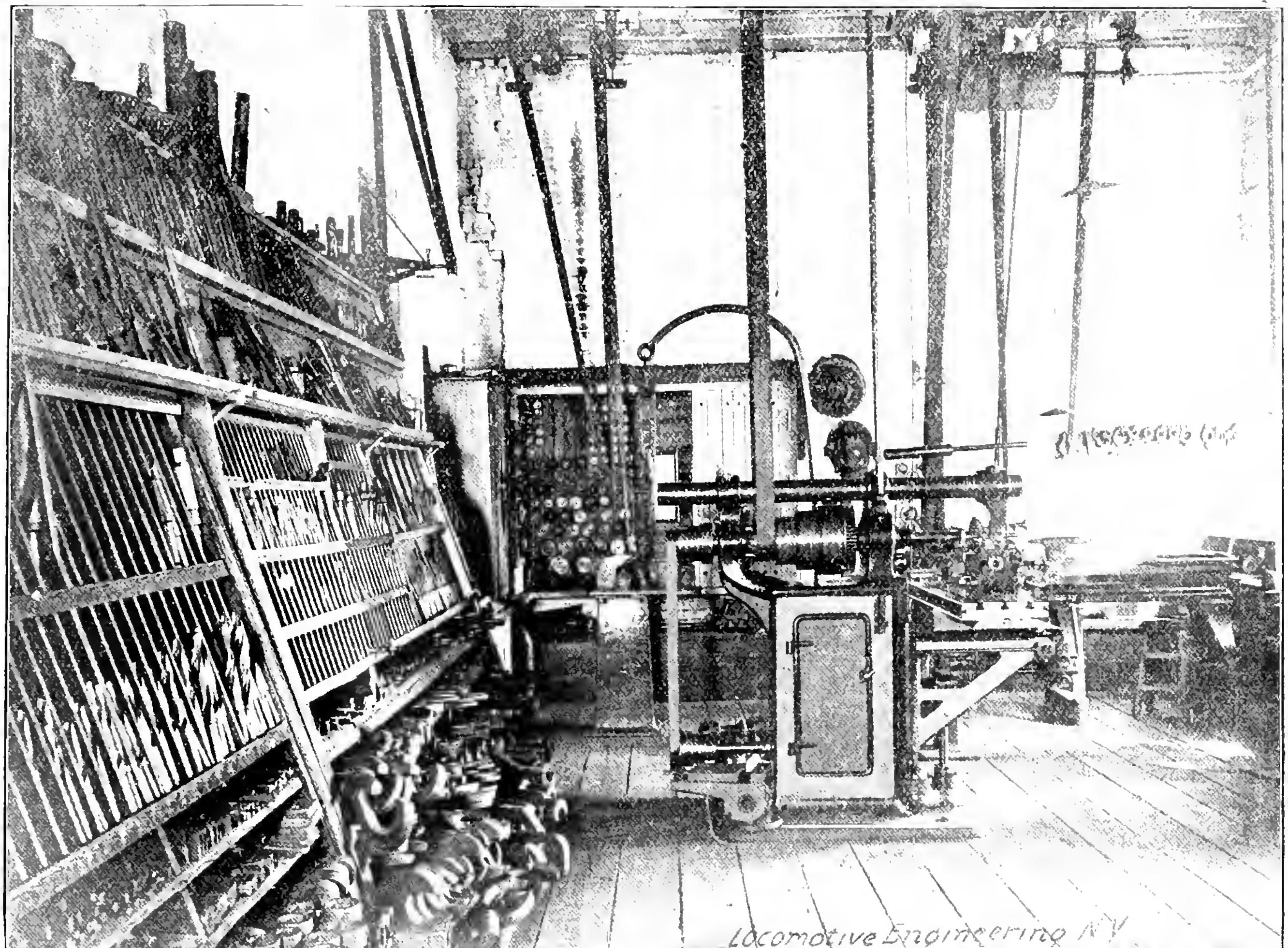
Mr. Cy Warman, the railroad poet of Colorado and author of "Sweet Marie," has been traveling in the Orient, collecting material for articles for *McClure's Magazine*. Cy appears to have directed his steps to the regions where the most picturesque phases of railroading could be observed. He went through the Holy Land, and made a very close study of railroading as displayed on the Jaffa & Jerusalem Railroad. He was impressed very unfavorably with railroading methods in Palestine, but he found a little railroad along the Suez Canal which he considered the best managed that he has seen in the East.

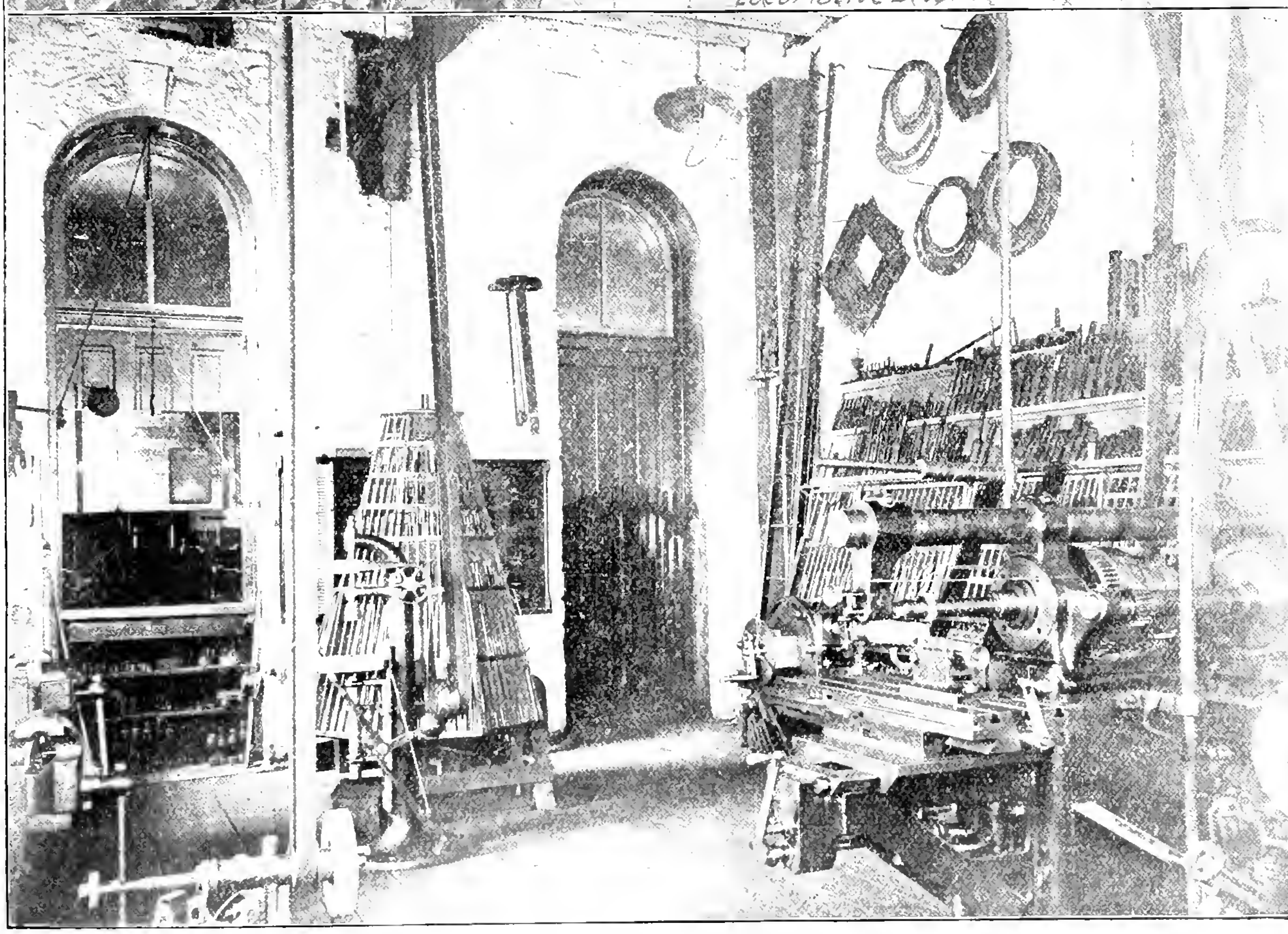
While going over the J. & J. R.R., Cy was moved to make comments on the Universal Brotherhood of section hands.

If the reader has ever ridden on the rear end of an American railroad train, and is of an observing turn, he has noticed that the moment the train passes a gang of section men they all fall to as vigorously as though they were repairing a wash-out and were holding the president's special. "Poor fellows," says the sympathetic traveler, "how they work!" He does not observe that every Irish son of them has one eye on the track and the other on the rear car, looking for the roadmaster. Well, they do that here, and the Arabs did it on the J. & J., just as the Chinamen do in California, and the negroes in Texas. Human nature is much the same the world over.

The Russian government has built five "church cars" for use in the sparsely settled sections along the line of the great Siberian road.

Now is the time to raise clubs. Cash commission.





Tool Room, M., K. & T. Shops, Parsons, Kansas.

Vacuum Gages.

The vacuum gage, like its prototype for pressures, has many forms to convey the information wanted. The most primitive of these is the bent glass tube containing mercury. The newer and recent ones are constructed similar to and look like a pressure gage, and the resemblance is so striking that many who use them do not

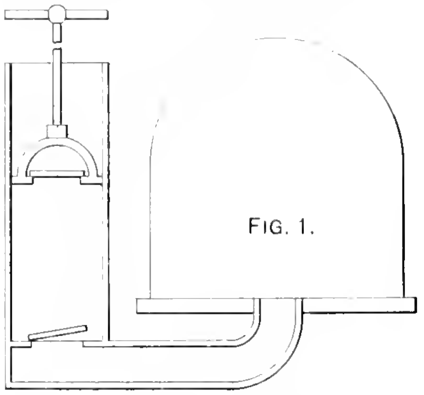


FIG. 1.

LOCOMOTIVE ENGINEERING N. Y.

fully recognize the difference between them, or at least fail to understand the principles of its action. Let us first see what a vacuum is. It is defined as a "space empty or devoid of all matter." From nature's abhorrence of this condition we need not expect, then, to have a perfect vacuum, but must be content with such as we can get. The nearest approach to the perfect vacuum is obtained by the aid of the air-pump, which, being connected to the vessel or receiver, exhausts the air from it to a certain degree; the interior of the receiver is then nearly a vacuum. Fig. 1 shows how this is done for experimental purposes. How to measure this vacuum brings us back to our starting point, and we will take the bent tube shown at Fig. 2 to show the conditions obtaining when the tube is filled with mercury up to line *A B*, and the two legs are in equilibrium; the reason why they are balanced is plainly because the end of both legs is open to the atmosphere, and as atmosphere is equal to 14.7 pounds at sea level, we have that pressure on the mercury in each leg.

If, now, we can by any means remove the pressure of the atmosphere from either leg, the pressure on the remaining leg will cause the mercury to rise on the side where pressure is reduced, and fall on the side that is subject to atmospheric pressure, and the amount of this rise and fall in the respective legs will be proportioned to the vacuum produced, or, in other words, will depend on the removal of air from the mercury in one leg of the tube. If it were possible to get a perfect vacuum in one leg of the tube, the atmospheric pressure in the opposite leg would force the mercury to a height of 29.922 inches, or 14.96 inches above and below line *A B* in Fig. 3, where a pump is shown attached to one leg, while the opposite leg is left open to the atmosphere. The whole subject is now resolved into a question of unbalanced forces, and the work done by the pump is given back by the atmosphere in raising the mercury through a distance of 29.922 inches. In Fig. 3 the mercury is shown 3 inches above the line *A B*, in the leg next to the pump, and 3 inches below it in the leg open to the atmosphere; the sum of this movement is equal to 6 inches of mercury, and since a cube inch of it weighs 0.4908 pounds at 32 Fahr., 6 inches will weigh $6 \times 0.4908 = 2.95$ pounds. To prove this we will multiply 29.922 by

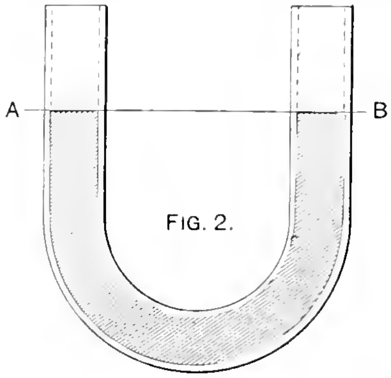


FIG. 2.

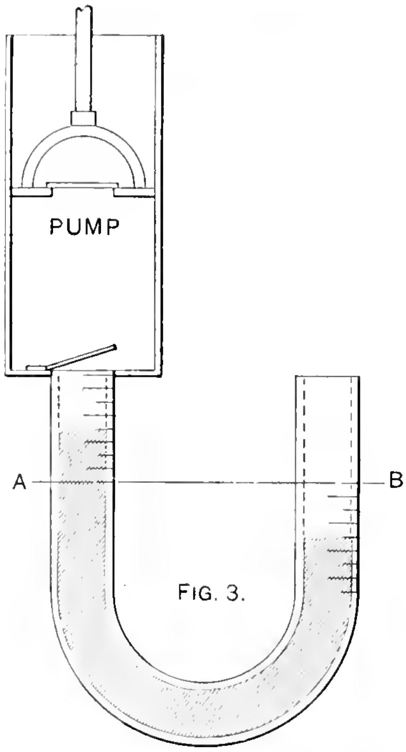


FIG. 3.

LOCOMOTIVE ENGINEERING. N. Y.

the weight of a cube inch of mercury, then $29.922 \times 0.4908 = 14.687$ pounds, or the weight of a column of air at sea level having a base of 1 square inch. Conversely, if we divide this column of mercury by the weight of the column of air, we have $29.922 \div 14.7 = 2.035$ inches of mercury to weigh 1 pound, therefore each movement of 2.035 inches represents 1 pound pressure on the atmospheric side of the tube, and this is the reason why a vacuum gage is made to indicate inches instead of pounds. When, therefore, it is desirable to transpose inches to pounds, it is only necessary to divide the total height of the mercurial column in inches by the height in inches of 1 pound. By the reading in Fig. 3 we have a total movement of 6 inches; therefore, $6 \div 2.035 = 2.95$ pounds, as before.

The vacuum gage in universal use is similar in principle to a pressure gage, as we have stated, but is graduated on the dial to read from 0 to 30 inches, as shown in Fig. 4, for the reason that its function as a gage to measure the degree of vacuum ceases when the atmosphere supports a column of mercury 29.922 inches high, for we have seen that the weight of that column is equal to an atmospheric column having the same base, and when the gage indicates 20 inches it shows that there is a difference in pressure between the exhausted side and atmospheric side equal to $20 \div 2.035 = 9.8$ pounds per square inch, which is therefore the weight of a column of mercury 20 inches high. The gage, then, indicates that this pressure on the vacuum side is 9.8 pounds below the pressure of the atmosphere.

This principle is made use of to measure the intensity of blast in furnace cupolas, but on account of the comparatively light pressure a water column is used; for, being lighter than mercury, the degree of blast is easily read from the column on account of the greater height of it for a given pressure. It is also made use of on locomotives to measure the vacuum in the smokebox, quickly telling the effect of any change in diameter of the nozzles or stack. Fig. 3 is a cheap and simple device for this purpose, when secured to a board and one leg piped to the smokebox of the engine. Graduating the board into eighths inches, the lines show through the glass, and any movement of the column can be noted.

The vacuum brake is a good example of how work is done by the aid of a vacuum.

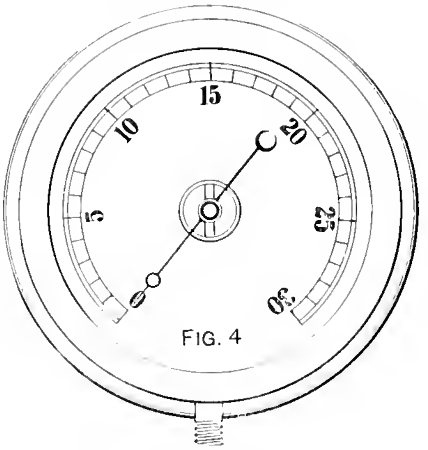


FIG. 4

LOCOMOTIVE ENGINEERING N. Y.

In this case steam is the agent for relieving the brake pipes of atmospheric pressure. This is done by a discharge of steam from the end of the piping system, and this steam discharge causes an induced current of air to flow from the pipes of the braking system, producing a partial vacuum therein, and the effect is exactly similar to that produced when a pump is used to exhaust the air, the vacuum differ-

ing in degree only; but whatever the degree of vacuum that is produced, we have seen that there is a corresponding pressure from the atmosphere, and it is this pressure on the diaphragms of the vacuum brakes that moves the brake levers and sets the brakes with an intensity due to exhaustion of air from one side of the diaphragms, or in other words, due to the inches of vacuum produced.

The condensing engine utilizes the vacuum to decrease the atmospheric pressure opposed to the piston. Taking the elements of the preceding case, in which we had a vacuum due to a column of mercury 20 inches high, we would have

The pump, as in the case of the exhausted receiver, the induced currents of air, as in case of furnaces and smokeboxes, and the condenser, as in the condensing engine are all familiar examples, coming under every-day observation.

O. H. R.

He Knew All the Answers.

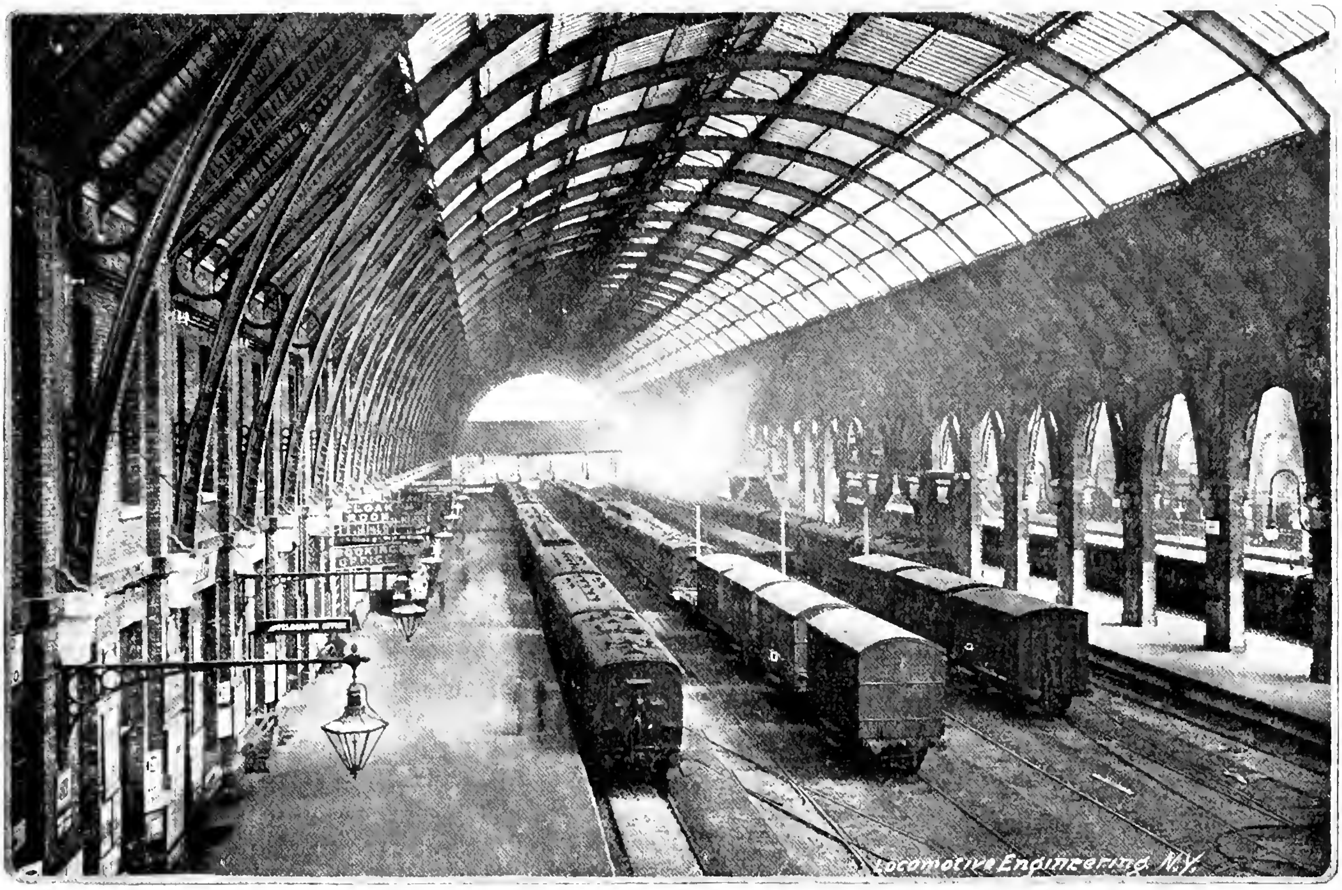
"Now, Cromwell," said the master mechanic, after rawhiding the brightest fireman he had on an hour's examination, "just one more question and I think you'll do.

"What would you do if you had a little

Pressure Gages.

The methods of measuring pressures of fluids by gages have been common property so long that it may appear like resurrecting one of the Ptolemies to show the principles underlying their construction, but as it is a fact that there is only a vague understanding of the matter among many who are brought intimately in contact with it, we shall devote a little space to a talk concerning the reasons for building the gages as we know them, and get acquainted with the theory of their action.

As their name indicates, they are intended to gage or measure something, and their registry, of course, shows the in-



East Coast Departure Platform—King's Cross Station, London, Eng.

$20 \times .4908 = 9.8$ pounds per square inch, and this shows that the pressure in the condenser is 9.8 pounds below the pressure of the atmosphere, and this also means that there is $14.7 - 9.8 = 4.9$ pounds absolute pressure retarding the moving piston instead of 14.7 pounds, which is the back pressure due to atmosphere when no condenser is used. It is apparent, then, that there is a gain of 9.8 pounds per square inch in the pressure on the piston when a vacuum of the degree noted above is present to relieve atmospheric pressure, and if it were possible to have a perfect vacuum in the condenser, *all* of the pressure of the atmosphere would be taken from the front of the advancing piston, and the gain would then be 14.7 pounds per square inch.

accident and broke the right-hand main pin, the left-hand link, the right lifter, and knocked a hole in the tank—how'd you get your engine in?"

"Well, sir," said the fireman, thoughtfully, "I think I'd get a piece of chalk and mark on her tank: 'Set on shop track for general repairs!'"

He got his certificate.

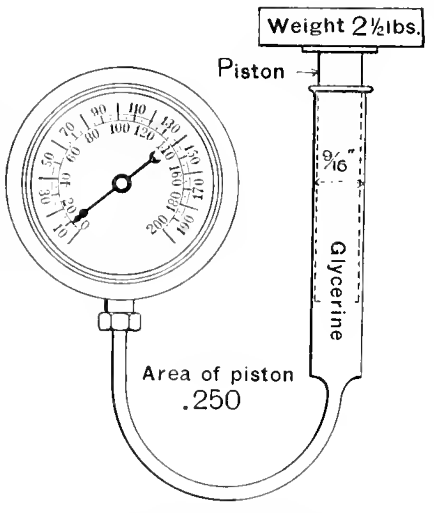
The Richmond Locomotive Works round off the face of the large piston head of the compound locomotives. This is done to prevent the edge of the head from cutting into the cylinder when the engine is working water and the piston is sprung. It works very well.

tensity of pressure in pounds or tons, or any other unit per square inch. There are many, too many, kinds and types of pressure gages on the market, guaranteed to register pressures accurately, and most of them register nothing except the dishonesty or incompetency of their builders; but there are some good ones, and when the selection of a gage is placed in the proper hands, there are no prospects of any one being badly deceived. There is one general principle pervading the construction of all, and that is the way the pressure is received by the gage and transmitted to the pointer, they all depending on the movement of a metallic connection to the pointer, where the motion is multiplied by an arrangement of levers suitable to give the pointer a proper movement for

the pressures carried. We need trace this movement in one gage only to show them all. Taking the well-known Utica, there is a brass diaphragm to receive the steam from the boiler; the plates of this diaphragm are elastic enough to yield slightly to internal pressure, and the movement of top plate actuates the lever resting at its center, giving it such a vertical motion that the gear segment on its end, meshing into the pinion which is secured to the same spindle with the pointer, causes the latter to perform its journey around the face of the dial.

As it is well known that most gages will not preserve their accuracy when subjected to the trials of service—that is, they either show too much or too little pressure —an attempt has been made to provide a means of adjustment in the gage under consideration. This is accomplished by changing the lever arm which controls the segment actuating the pointer when necessary to rectify the reading; and, by the way, several years in the tool room brought out the virtues and weaknesses of these silent monitors in a way that left a lasting impression, for that is the place to see some of these danger signals at their worst, as it is then possible to compare their actual condition with what it should be. But it was generally found that few gages had any provision whatever for adjustment. The mechanism of a gage is necessarily delicate, as it must needs be, in order to be as nearly frictionless as possible, and when a thought is given to the pressures they are under, and the little attention they receive, it is a matter for surprise that a good one will remain in that condition very long. Various devices are in use for testing the accuracy of a gage, among which are the hydrostatic tester, having a test gage *supposed* to be correct. The gage to be tested is secured to the same pipe with the test gage, and a pressure applied by a pump shows at once a comparison of the old and new, as the same pressure is on both gages. This method is seen to be a good one, provided the test gage is known to be correct, but here is where the fabric of this scheme goes to pieces, for the test gage, subject always to the same ailments as the others, is likely to give an incorrect reading.

The measure of accuracy is also sometimes found for gages by means of the pressure of a column of fluid, as water, oil or mercury. For example, a cube inch of water weighs 0.0361 pound, and a column equal to atmosphere will be $= 14.7 \div 0.0361 = 407$ inches or 33.91 feet high to balance the weight of a column of air having a base 1 inch square, or a temperature of 39° Fah. at sea level, and 1 pound per square inch will be equal to a height of $407 \div 14.7 = 27.68$ inches. Thus, for a gage graduated to indicate, say, 200 pounds per square inch, we would require a column equal to $27.68 \times 200 = 5{,}536$ inches or 461.3 feet. It is not probable that any enthusiast on the subject will ever make an effort to use nature's forces at any such cost as this, and we must turn to mercury if we expect to get a column of a height that will be within reason's boundaries. A cube inch of mercury weighs 0.4908 pound, and $14.7 \div 0.4908 = 29.922$ inches high, and is, therefore, the height of a column which, at 32° Fahr., will equal the pressure of atmosphere at sea level. A pressure of one pound to the square inch will then equal $29.922 \div 14.7 = 2.035$ inches. We can now get the height of a column which will be equal to the boiler pressure used in the previous case: $200 \times 2.035 = 407$ inches or 33.9 feet high, to give the required pressure of 200 pounds. While the results obtained by this method are very accurate, varying slightly by changing temperatures, the want of head room renders it impracticable for everyday use, and especially so for shop practice,



where the demand for simple and practical appliances is in direct opposition to anything with the faintest semblance of a frill.

A gage tester that measures the pressures by means of known weights is the most reliable of these devices, for it is possible with it to test a gage without the assistance of any other gage.

There are a few of these in use, among the best of which is one having the load transmitted from the weight through glycerine, or any heavy clean oil. This device consists of a pair of hollow columns, supported on a suitable base. The gage to be tested is secured to one column, and the other column is fitted with a piston resting on a non-elastic fluid. It is apparent that any weight designed for the area of the piston will transmit its pressure to the gage, multiplied by the difference in area of tube opening of the gage, and a comparison of the reading on the gage being tested with the known pressure per square inch due to the weights furnishes an unerring index of the gage's accuracy. From its simplicity, there is no possible chance for error when the proper weights are used. The illustration shows a piston $\frac{9}{16}$-inch in diameter, and the area is therefore 0.2485 square inch, and we shall call it 0.25 or ¼ of a square inch. The weight shown is 2.5 pounds. From the formula $P \div A = S$, which reads pressure divided by area equals unit stress (in this case the pressure per square inch), we know that $2.5 \div 0.25 = 10$ pounds per square inch, as shown on the gage.

Now, for any other pressure it is only necessary to have the proper weights, and they may be found by multiplying the required gage pressure by the area of piston. Taking the same elements as before, we have: $10 \times 0.25 = 2.5$ pounds for the weight, and for any other pressure, say $150 \times 0.25 = 37.5$ pounds, to register a pressure of 150 pounds on the gage.

These weights should be marked for their corresponding gage pressures instead of their weight in pounds, and should be made like the ordinary scale weights, with ribs and recesses, to insure central adjustment when on the piston.

One of these would be a saving investment for any railroad company to have on tap at every roundhouse on the system. The question so often asked as to the health of the test gage—the gage that is guarded as though it were a pearl of great price, but is too often a gifted and Janus-faced falsifier—is heard no more where this tester is used.

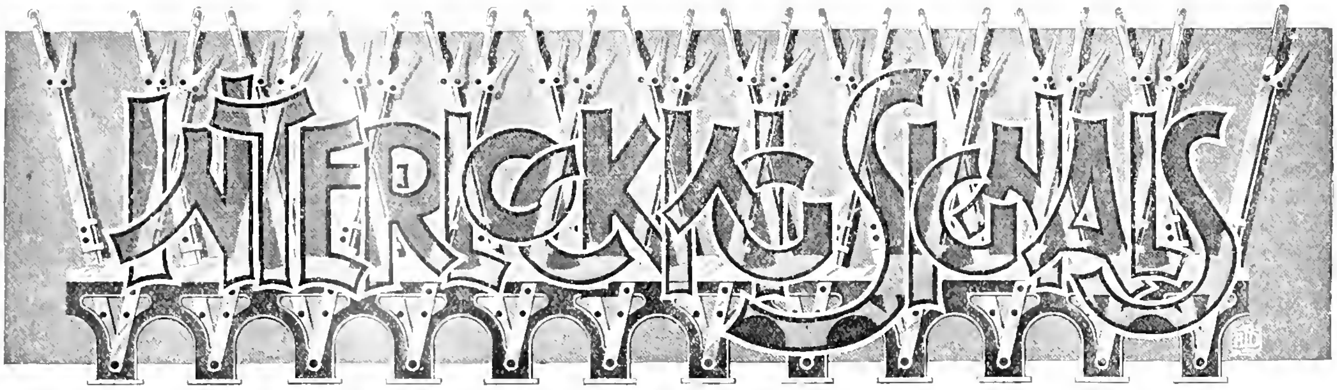
O. H. R.

Favors Adoption of Standards.

In his opening address at the September meeting of the Central Railroad Club, President Higgins said:

"At the convention of 1894, the Master Mechanics' Association adopted the specification for boiler tubes. This year they have adopted a standard gage for measuring sheet metal, wire, etc., known as the decimal gage, and I think the sooner we all of us go into the decimal gage the better it will be for us, as well as for the parties who furnish the material on which that gage will be used. The road with which I am connected is now considering the adoption of this gage, also the specification for boiler tubes. The boiler tubes specification, however, will be somewhat modified to meet our own special requirements."

We are glad to see this public expression favoring the putting into practice the standards adopted. It is very desirable that the decimal gage should be brought into general use for measuring sheet metal, tubes, wire, etc. The Executive Committee of the Master Mechanics' Association are laboring to induce railroad companies to adopt this gage, and it is to be hoped they will succeed. The Pratt & Whitney Co. have agreed to manufacture the gage, if a sufficient number is ordered to remunerate them for making the special tools necessary. Several railroad companies have ordered gages, and there are good prospects that many others will soon take similar action.



By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

The Stevens Machine, and How a Switch is Moved and Locked.

[ELEVENTH PAPER.]

The machine constructed by Messrs. Stevens & Sons has been much improved since the first one was made, and while the general plan is very much the same, the arrangement of the small parts differs considerably. The improvements made have been, principally, in the arrangement of the latch connection, by which the preliminary locking feature is obtained, and in the design of the special locking.

Two forms of the machine are manufactured and have been quite extensively introduced. That made by the National Switch & Signal Co. is shown in general view in Fig. 1, a drawing of the machine being shown in Fig. 2. As will be seen, all of the parts by which the locking is accomplished are carried on the main frame beneath the flooring, where it is out of the way, nothing being put above the top of the frame but the levers which the signalman has to pull. This gives the machine a very neat appearance, and makes it very easy to keep the tower clean.

The detail parts of the levers are much the same as in other machines, but the rocker (*R*, Fig. 2), instead of being placed on top of the frame alongside of the quadrant, is suspended underneath, the latch rod *P* being brought down to engage with and move it whenever the latch is raised or released. A link *S* connects the rocker with a "tappet" bar *T*, and prevents the rocker, and therefore the latch and lever, from being moved unless the locking dogs, carried in the frame behind the tappet bar, are in such a position as will allow of the tappet bars being moved. This arrangement is a very simple and strong one, and admits of the power being applied in a very direct manner.

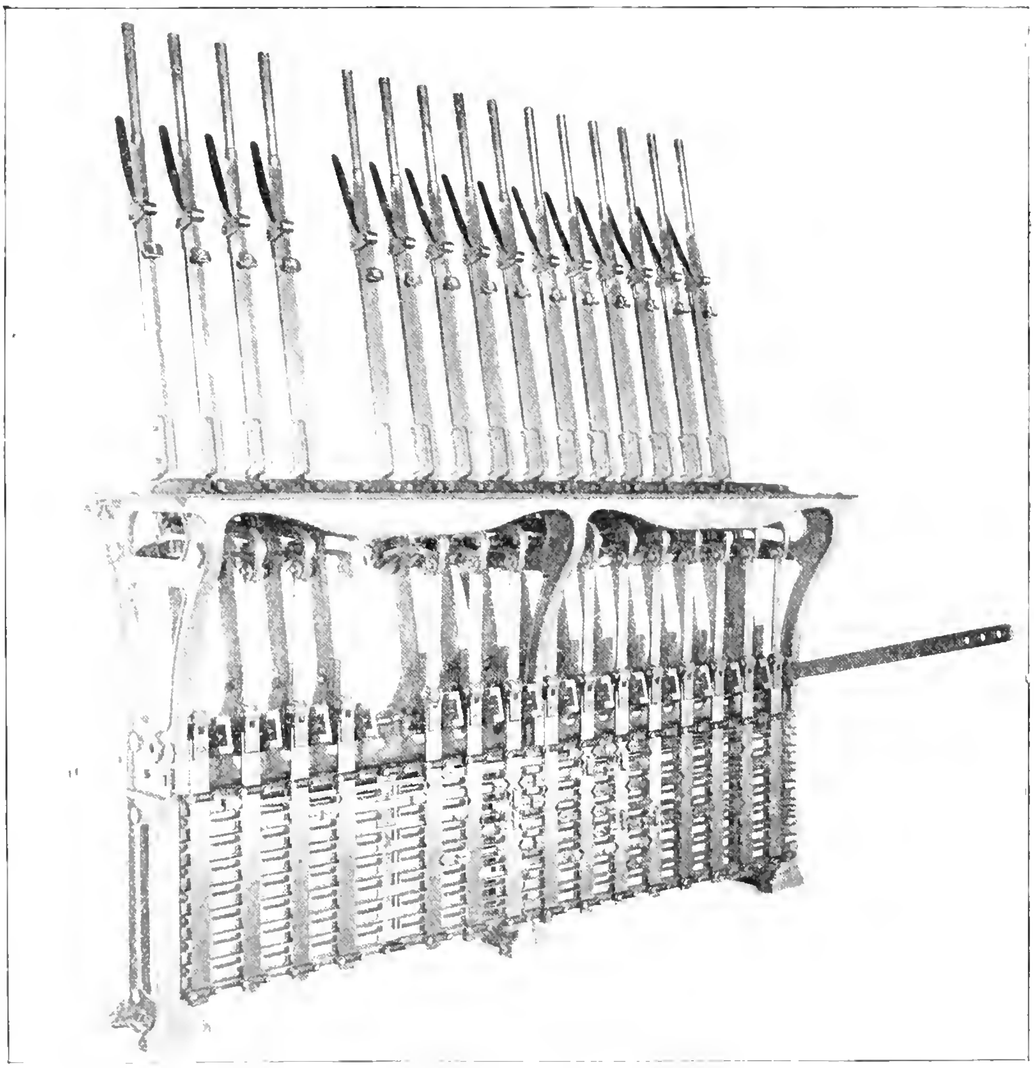


Fig. 1—The National Interlocking Machine.

The arrangement of tappet bars and locking dogs, by which the locking of the levers is accomplished, is shown in Fig. 3, tappets being numbered the same as the levers to which they are connected. The locking sheet from which this arrangement of locking is made is as follows, being the locking required for the levers controlling a plain crossing, such as was shown in a previous article.

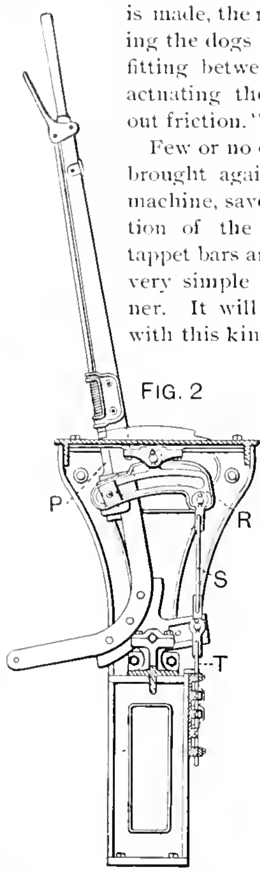
The mechanical construction of the locking is simply that of a bar or tappet locked by a dog moving at right angles to it, and fitting in a notch cut in the edge of the tappet bar. This dog is made longer than the distance between any two tappet bars,

the levers of which it is desired to lock, so that one bar will be free to move only when the dog slides into the notch cut in the other bar. Unless the notch in the other bar is in a position to allow the dog to be forced over, the bar is locked and the lever cannot be moved.

Any locking required is very easily arranged in the machine, as the dogs are made by screwing tapered pieces of the proper form to small bars of the length required to fit in the notches which are cut in the tappet bars. As the width of the dog is three times that of the small connecting bar, three dogs may be made to work in the same space in the frame by fastening the dogs to the top, middle or bottom bars. In this way a great deal of locking may be arranged in a very small frame space, and at the same time may be gotten at easily.

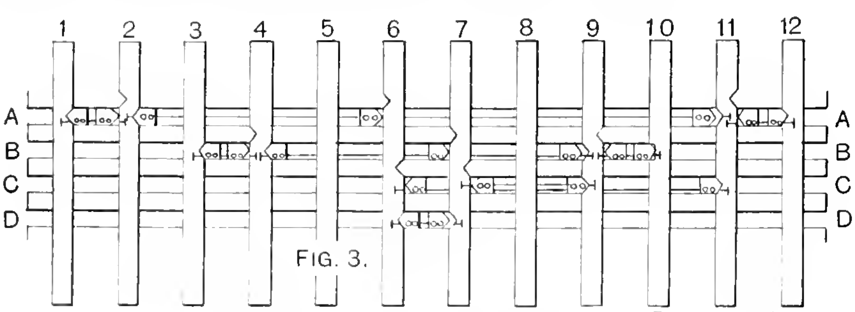
The special locking used by the National Company is that known as the Pfeil anti-friction disk locking, and as applied to their machine is a very simple and easily arranged contrivance. It consists simply of a small ring held by a frame or "cage," fastened on the outside of the tappet, as shown in Fig. 4, special dogs being used, which not only fit in the tappet in the ordinary manner, but project over the bar and bear against the ring. If the tappet is in a position where the ring is held in between the two, they will practically act as one, while, if the ring is withdrawn, both dogs will be free to move. In this way one lever is made to lock another lever only when a third lever is in a certain position, normal or reversed, whichever is desired. By making cages to hold several rings, and by using dogs of special form, any special locking, no matter how complicated, can be easily arranged.

The claims made for this style of machine are "that as the rocker is made with either single or double tappet connections, single or double locking can be used, placed on either side of the frame with equal convenience and accessibility, thus doubling the capacity, the symmetrical unobstructed view of every part, and thus not only facilitates free inspection but permits the placing of new locking (for additional levers), or the introduction of special locking, with the greatest convenience and economy; that by using a rolling movement for the special locking there is no sharp blow when the movement is made, the rings easily pressing the dogs apart, accurately fitting between them, and so actuating the locking without friction."



Details of National Machine.

Few or no objections can be brought against this style of machine, save in the construction of the locking, as the tappet bars are connected in a very simple and direct manner. It will be noticed that with this kind of locking the dogs extend from one end of the machine to the other, instead of across the locking bars, as is the case with the improved Saxby & Farmer locking. Making the bar long in this way means that it will require more force to drive it, and as the bar is driven by sliding friction between the end of the dog and the notch cut in the tappet, it is very apt to cause wear. Again, as the dogs all lie in a vertical plane, any wear will take place on one side only, and will in time affect the locking, possibly necessitating its renewal much sooner than with the other style of locking.



Dog Sheet, National Machine.

construction of which secures the greatest economy of room and minimum cost of maintenance, for the reason that more locking can be carried in less space and with less cost than in any other machine—a feature of special importance in all installations; that the locking frame is so designed that the locking is open to the

While the Pfeil special locking answers the purpose admirably and takes but little power to drive it, the construction is not as good as it might be, as the wear is excessive, owing to the small surface on the ring that is brought in contact with the dogs. Measured on each ring the wear is very small, but where there are many rings working in multiple, the wear is cumulative and soon reaches that point where the tappet will not be locked and the lever can be pulled over when it should not be possible to do so. This objection, however, cannot be urged against the arrangement, if the form of the special is changed from a ring to a square, when a larger surface would be exposed to wear and it would last much longer.

The Johnson machine is illustrated in Fig. 5, a detail drawing having been shown in the article on Controlled-Manual Block Systems, the Patenall lock instruments having been applied to one of these machines. This machine differs from the one made by the National Co., in placing the rocker on a bracket fastened to and moving with the lever, instead of suspend-

Pfeil Anti-Friction Disk Locking.

ing it from the main frame. Practically the results are the same, as motion is imparted to the tappet both before and after the movement of the lever, as in the other machine.

Special locking is provided for by a loose dog fastened to the tappet, which acts in the same manner as the ring used with the National machine. Instead, however, of fastening this to the surface of the tappet, the bar is cut away to allow the dog to work in the same plane with the other locking dogs, a tie-piece being used to join the two parts of the tappet bar together.

This construction is objectionable and is not as good as the Pfeil arrangement, owing to the chance of the bar becoming disconnected and throwing the locking out of service.

With a machine having the rocker situated as it is on this one, the locking can be placed only on the front part of the frame, where it will be behind the pipe connections to the levers, and very hard to get at to make any changes or repairs.

While the improved Saxby & Farmer locking may take up more room than the Stevens locking, there is little doubt that it can be repaired more easily, owing to its being in a horizontal position, or that it will last longer, there being less friction between the locking bars and the dogs. However, both types of machines are strongly made, and will need but little repairs or attention beyond an occasional oiling, and whatever cleaning is necessary to keep every part clean and free from

gum, for if the locking is not kept clean it is apt to stick and give trouble.

Next to the machine, the most important part used in the construction of an interlocking plant are the movements by which the switch points are opened and closed

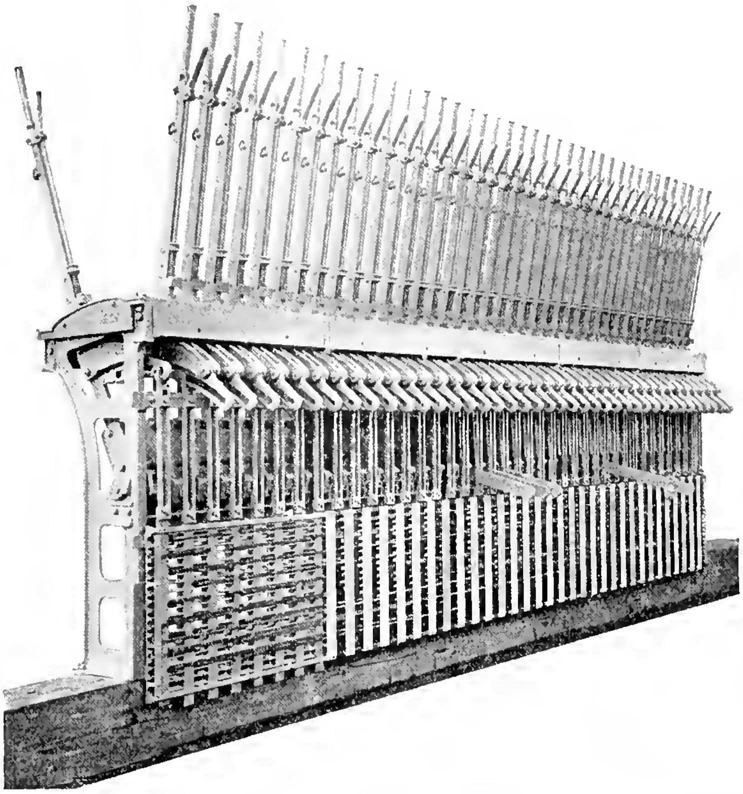


Fig. 5—The Johnson Interlocking Machine.

and also locked, whenever the lever to which they are connected is moved.

By far the simplest arrangement that can be used is to make a direct connection from the lever to the head rod of the switch, the same as if the connection was made from an ordinary switch-stand. This would provide for throwing the switch, but would not lock it, and as there is considerable spring in pipe lines used to make the connection to the lever, some form of lock with all facing-point switches is absolutely necessary to prevent the points from moving under a passing train.

Locks are easily made by attaching a rod to the points of the switch and providing a plunger or lock pin which can be entered into holes drilled in the rod, thus locking it, and with it the points of the switch. There are two forms of these locks which, as they are generally used at facing switches, are called "facing-point locks," one being placed inside of the line of rails, and shown in Figs. 6 and 7, and the other placed outside of the rails and shown in Fig. 8.

As will be noticed in the one shown in Figs. 6 and 7, the two points of the switch are connected together by a front rod, which answers for a lock rod by passing it through the plunger casting bolted to the tie, holes being drilled in the rod for the plunger to enter and lock the switch, either for the main line or for the side track.

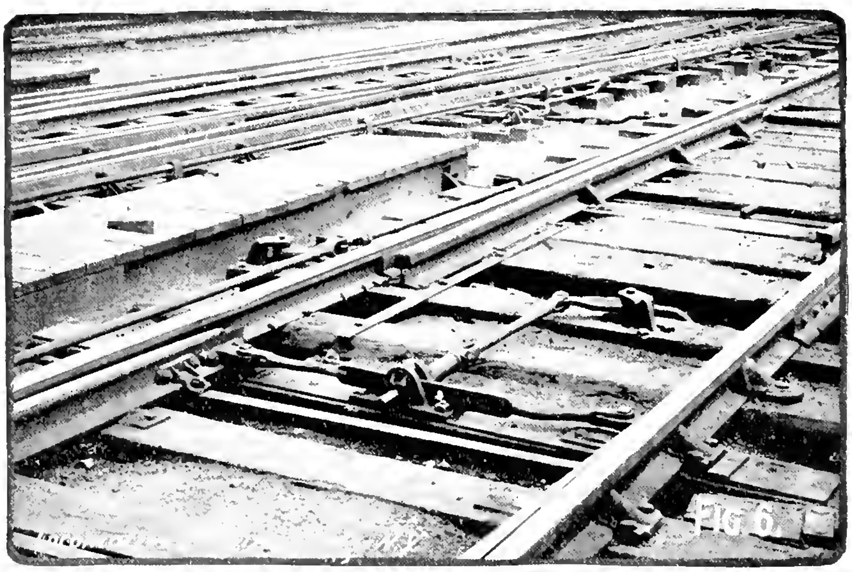
With the form shown in Fig. 8, the lock rod is attached to the front rod midway between the two points, and is made long enough to pass through the plunger casting which is placed outside of the rails, holes being drilled in the bar to lock the rod and with it the points of the switch.

Of the two methods, the second is the one ordinarily used and is much the best, as the casting is out of the way and not liable to be caught and torn out by any loose brake beam, or other defective part, on a passing train.

However, the inside lock is the only one in use in England, the claim being made for it that it is the strongest, and that by the lock being made a part of the switch it has got to be kept in working order.

Using locks such as are here shown to lock the switch, necessitates using a separate lever to work the lock, which, in a great many instances, is a very expensive arrangement. Where such are used, the general plan followed in numbering the levers and arranging the locking is the same as that which has already been described, except that the levers of the signals, when reversed, must lock the lever of the switch lock reversed in all cases, whether the switch is in the normal or the reversed position, for the reason that a switch should always be locked before it is used by a train, irrespective of the way the switch is set—the order in which the levers would have to be reversed to set up any route for a train being: First, the switch or derail lever; second, the locking lever; third, the home-signal lever, and, last of all, the lever of the distant signal.

Owing to the cost of providing two levers to move and lock a switch, and the time required to pull the second lever, many attempts have been made to perfect a machine which would accomplish this by the movement of one lever. The result has been the invention of the switch-and-lock movement, which can be said to be a practical success, the principal feature of the design being the preliminary action of unlocking the switch before the points are moved, and then locking them again after

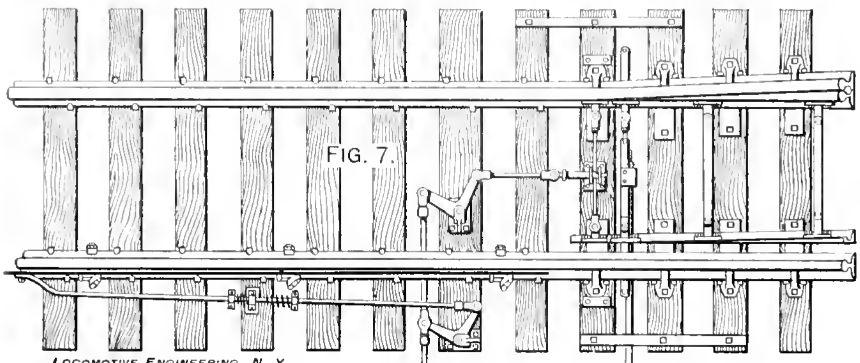


Inside-Connected Facing-Point Lock.

the movement has taken place, very much the same as the preliminary latch locking acts with the levers of the interlocking machine.

A general plan of a switch-and-lock movement, showing its construction and the connections to the switch, is shown in Fig. 9, a detail drawing of the movement being shown in Fig. 10. A is the base

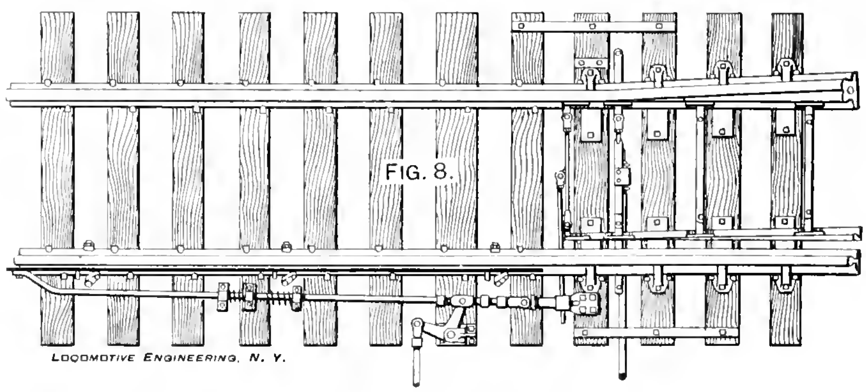
casting, having a guide at one end, through which the lock bar *L* is made to pass. A slide bar *R* is connected by a pipe line to a lever in the tower, and is moved a distance of 8¾ inches whenever the lever is reversed or returned to the normal position. Riveted to the slide bar are two lock pins *P*, which are made to enter holes



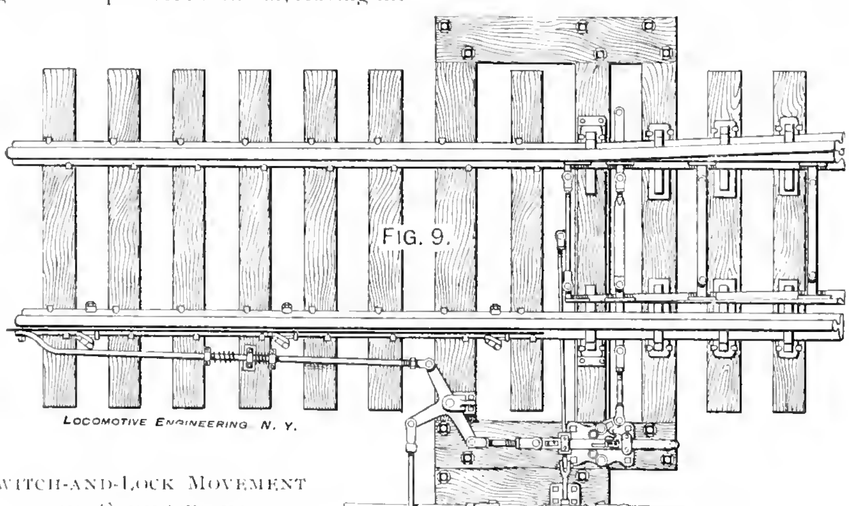
CONNECTIONS TO INSIDE-CONNECTED FACING-POINT LOCK.

drilled in the lock bar, and lock the bar with the base casting, so that it is impossible to move the switch until the slide bar is moved and the lock pin withdrawn. Working on one side of the slide bar is a switch crank *C*, which bears against an operating or driving pin *D*, fitted between the upper and lower bars of the slide bar *R*, and is connected to the switch rod by a short connecting rod.

The switch being shown in the normal position, if, now, the man in the tower should reverse the lever, the movements that would be made would be as follows: The slide bar would be moved, withdrawing the lock pin from lock bar, leaving the



OUTSIDE-CONNECTED FACING-POINT LOCK.



SWITCH-AND-LOCK MOVEMENT AND CONNECTIONS TO SWITCH.

switch points free to be moved, the operating pin sliding along the straight surface of the switch crank. After the switch had been unlocked, the operating pin would strike the arm of the switch crank *C*, causing it to revolve and carry with it the switch and lock bar, the throw of the crank being regulated so that when the switch had completed its movement the operating pin would slide along the other arm of the crank, entering the lock pin in the other hole in the lock bar, locking the bar and the switch in its new position.

Theoretically the results obtained are the same as when separate levers are used to work and lock the switch, but in practice it is found that the use of the switch-and-lock movement has some limitations beyond which it cannot be said to be good practice to go.

The weak point in the movement is that with the short motion available there is not travel enough in which to make the locking of the switch certain, owing to the spring in the connections when the switch is any great distance from the tower. As with the locking of the levers in the tower, it is taken for granted that if the lever is pulled over for its entire distance the switch has been thrown, and it is therefore possible to reverse other levers which depend for safety on the fact that the switch is properly set and locked. Any plant cannot be considered safe where the switch-and-lock movement is such a distance from the tower that it would be possible to reverse and latch the lever, owing to the spring in the connections when the lock pin had not entered the lock bar, as would be the case if something should get in between the points of the switch and prevent it from closing.

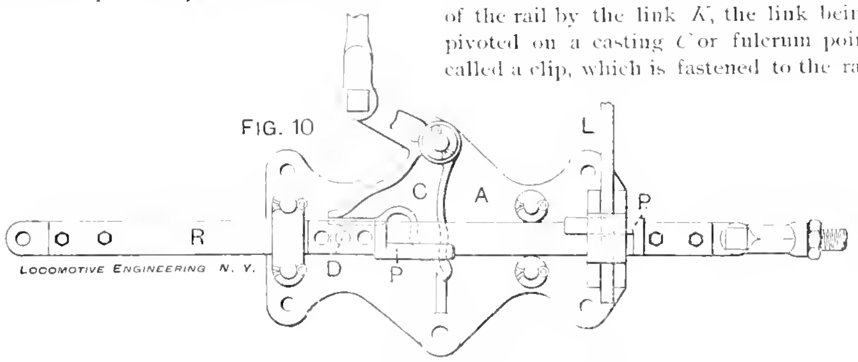
If a bolt lock was put in the connection to the signal, it would be impossible to clear the signal if the switch was not properly closed; but as it is not practicable to put a lock on the signal for every switch which the signal may be used to govern, dependence must be placed upon the switch being closed properly when the lever is pulled over.

No definite distance can be laid down beyond which it would be unsafe to go, as the number of cranks and any curves which may be in the pipe line will materially affect the amount of spring and lost motion in the connections. Then, again, the number of movements that are placed on a lever will also make a difference in the chances of failure, owing to the greater power required to work the switches.

My experience has been that a switch-and-lock movement for distances up to 500 feet is a safe and easy method of working a switch, but beyond that I would advise a facing-point lock, although the latter cannot be said to be a perfectly safe arrangement. Instances can be named where serious wrecks have occurred from a failure of a facing-point lock, owing to a break in the switch connection allowing the lever to be reversed without closing the switch, the plunger entering the same hole in the lock bar when its lever was reversed, and locking the switch in the same or open position. On the Pennsylvania a staggered lock is being tried to prevent an accident of this kind happening, the staggered lock being made with two lock bars and two plungers of different shapes, which fit in different-shaped holes cut in the bars; so that unless the switch has been moved, the plunger cannot enter the hole in the lock bar and the lever cannot be reversed, and so the signal cannot be cleared.

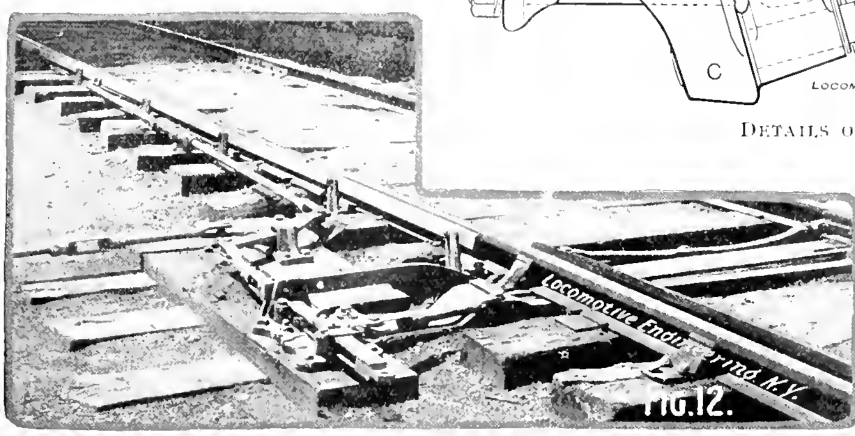
More than two switch-and-lock move-

ments should not be put on one lever, as the power required to work them would be more than it is safe to put upon a pipe line. While it may work well for a time, the wear upon the parts would be so great



DETAILS OF SWITCH-AND-LOCK MOVEMENT.

that very soon there would not be throw enough at the movement to cause the plunger to enter the hole in the lock bar and lock the switch. Again, the power required to work three movements is often more than one man is able to exert, and by getting another man to help pull over the lever there is great danger of doubling



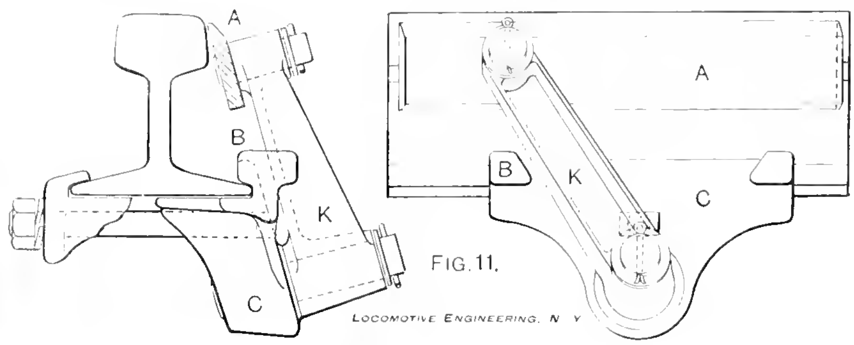
GENERAL ARRANGEMENT OF SWITCH-AND LOCK MOVEMENT AND CONNECTIONS TO DETECTOR BAR.

up the pipe should anything prevent one of the movements from closing, the lever being reversed while the switches would be open. More especially would this be likely to happen in winter, when the cranks, the movements and the switch points are apt to be clogged with snow and ice.

A very important part of the apparatus that is designed to work in connection with a switch-and-lock movement or a facing-point lock, and which, as yet, has not been spoken of, is a detector bar or slide, which prevents any movement of a switch or lock being made so long as any wheel of a train may be on the bar. The necessity of providing some such arrangement as this is apparent, as without it, it would be possible for a signalman to throw a switch under a moving train—not that he may do so intentionally, but to prevent his pulling the lever by mistake, thinking, perhaps, that the train had cleared the switch.

The construction of a detector bar is shown in Fig. 11, and the arrangement by which connection is made to the crank that moves the switch can be seen in Fig. 9. *A* is the bar which is held against the side of the rail by the link *K*, the link being pivoted on a casting *C* or fulcrum point called a clip, which is fastened to the rail as shown. Lugs *B* are provided on the clip, which limit the movement of the bar and prevent it from ever being allowed to get too much out of adjustment.

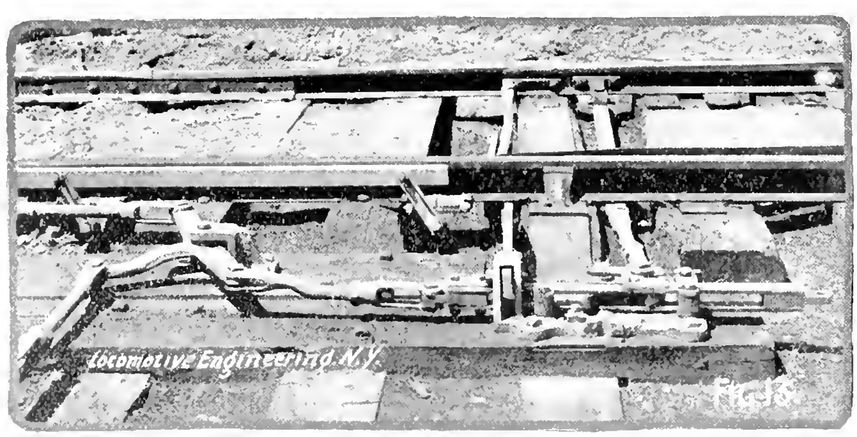
When an attempt is made to throw the switch, the first movement of the crank moves the connecting or driving rod of the detector bar and causes the bar to move through the arc of a circle, with the pin of the clip as a center and the link as a radius. This brings the bar to the top of the rail, raising it to about one inch above when the bar is in the center, or has been moved through one-half of its stroke. If a wheel was on the rail at the time the attempt was made to change the switch, the bar would be raised, striking against the outer edge of the tread of the wheel, which projects about an inch over the side of the rail, and no movement of the switch and lock movement could be made, and therefore the switch could not be changed. As the bars are made 45 feet long, and are placed alongside or ahead of the switch,



DETAILS OF DETECTOR BAR.

so that the wheels would first pass over the bar before getting to the switch, it is impossible to change the switch under any part of the train, as this length is greater than the distance between any two pairs of wheels of any car or engine, or of any two cars that may be coupled together.

The general arrangement of a switch-and-lock movement and the connection to the detector bar are shown in Fig. 12, the photograph helping to make the drawing more easily understood. When a facing-point lock is used, in place of a switch-and-



SIDE VIEW OF SWITCH-AND-LOCK MOVEMENT AND CONNECTIONS TO SWITCH.

lock movement, the detector bar is connected to the lever that works the lock, so as to make it impossible to unlock the switch while a train is passing over it. If

there is no room in which the bar may be placed ahead of the switch, it is usual to use two bars, one on each outer rail, thereby insuring that it will be impossible to change the switch under a train when either track is in use. As the detector bar makes it impossible to change the switch so long as a pair of wheels are on the rails over the bar, it is necessary for an engineer to run by the switch sufficiently to clear the bar, if he wishes the switch to be changed before going in the opposite direction. To have to do this seems to trainmen a useless precaution, and they often blame the signalman for making them run further than is apparently necessary, whereas the man is powerless to make any change until the bar is cleared. Trainmen should never stop their trains with any of the wheels over the bar, for if they do so, they have not cleared the interlocking, and until they do so clear it the switches cannot be changed or a route set for any other train.

Training of the Mechanical Engineer.

In the introduction to a lecture delivered at the Stevens Institute of Technology, Dr. Coleman Sellers said : "Mechanical engineering, as a profession based on scientific methods, has its whole life coincident with the professional career of men yet workers. The names highest on the roll of fame belong, in many cases, to men who have not had your advantages. Many very able engineers suffer, too, for the want of what you may have considered the drudgery of your work in school.

"Mathematics, as taught in the schools where such men as Oliver Evans, at the beginning of this century, and many engineers now living received their early instruction, was limited to the rules of arithmetic, with too little knowledge of algebra to be worth the name, and very little of the higher mathematics. The theories of thermo-dynamics did not guide the men who brought the steam engine to its perfection. Written thermo-dynamics is the study of the steam engine as worked out tentatively.

"There are minds naturally fitted to master mathematics, while others find such study irksome. It is, however, noteworthy that mechanical engineers of great mathematical ability have made, in constructive engineering, as great mistakes as those who lay no claim to such knowledge. The inventive faculty, so needful to an engineer, grows with practice and is susceptible of cultivation. With what has been accomplished by educated, as well as uneducated minds, each year calls for a greater talent to improve on what has been done, or to fill new wants.

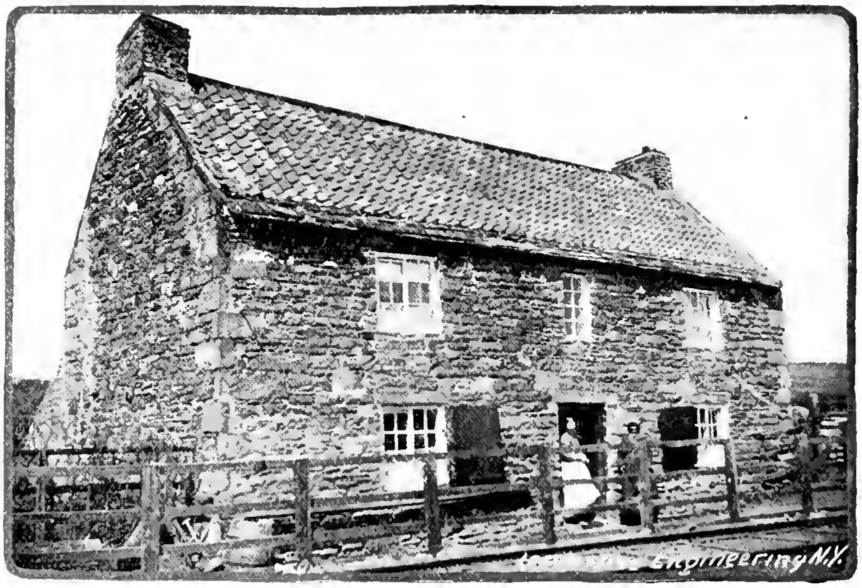
"If you inquire into the life history of men who, with little opportunity, have achieved distinction as engineers, you will find that to natural ability has been added the result of deep thought, close application to business, and memory well stored with observed facts. Such men have been students all their lives, and they have had to depend upon and know how to select others to help them. Thus, an engineer lacking the ability to work in the way you have been taught to labor, usually employs those who have been educated, checking the results of their figures and their ideas by his own practical knowledge.

"Presuming you may be sought for in such work, you can be the more useful and fill a broader plane of utility if you are made familiar with some of the customs and usages of the existing engineering establishments, where men of all capacities are employed, and where it behooves those who would know how to manage to familiarize themselves with shop customs. If, too, you are employed to serve, and not to manage, this foreknowledge will enable you to appreciate customs that may seem antagonistic to what you have learned in school."

bear the hand on them. The only receptacle for oil was a ¾-inch hole, cast in strap, which would hold about two thimblesfull of oil, and still the master mechanic could not understand why they would run warm. I just mention this as an 'object lesson for Jim' in case he calls on you."

Roundhouse Floors.

Among an attractive array of subjects to be discussed at the meeting of the Southern and Southwestern Railway Club, to be held at Atlanta, November 21st, is a report to be presented on "A Durable and Cheap Roundhouse Floor." If the committee can recommend something which combines durability and cheapness they will succeed in filling a long-felt want. So far as we have been able to watch roundhouse floors, we have never yet found one that was durable, no matter how expensive it might have been originally. The hot water ruins all made of composite material, and if they are made of stuff that the water will not injure, pressure of screw-jacks and other weights break the surface. It seems, however, that some material might be found that would withstand the varying changes to which a roundhouse floor is subjected. The subject of roundhouse floors has never before, as far as we are aware, been publicly discussed. The information brought out at the Atlanta meeting will be read more attentively than anything discussed lately.



BIRTHPLACE OF GEO. STEPHENSON, THE FATHER OF THE LOCOMOTIVE, AT WYLAM, ENG.

A Distinction Without a Difference.

A young man who hustles for an oil house writes us interesting private letters about his experience. To show how the wrong thing is often blamed when something gets hot, he relates the following :

"Some time since I was sent to an Eastern road to look up the cause of eccentric straps running hot on some of their passenger engines. I found the engines complained of to be of the American type, and burning anthracite coal. In order to prepare the fire to be in condition to start with, it was kept so heavy that a small stream of water was kept running on driving boxes while engine was in roundhouse, in order to keep them cool, but for some reason it was not considered necessary to give eccentrics and straps the benefit of the shower-bath, and when engine was coupled to train to start on a run of 47 miles, before the first stop was made eccentric straps ran so hot one could not

Fireman A. La Rue, of the P. R. R., was killed on the night of October 5th by a disarranged load of lumber in a freight train, which was going in the opposite direction on another track, striking the cab of his engine.

Recent Improvements in Self-Acting Injectors.

Owing to the introduction of the compound locomotive, there has been during the last few years a general tendency toward higher pressures for locomotive boilers, resulting in an increase in the standard pressure for the new motive equipment on almost all lines, from 140 and 160 pounds to 180 and 200 pounds per square inch.

This change demands further improvement in the injectors for supplying the boilers with feed water, for many of the well-known patterns which would work satisfactorily at the lower steam pressures are entirely inadequate to supply a boiler efficiently under the new requirements.

The problem presented to manufacturers was to furnish an injector which would operate economically at 200 pounds steam, admit of wide fluctuations in the steam pressure without waste at the overflow, and start and work steadily at the low pressures used in the roundhouse; the higher the maximum limit of steam pressure, the greater the difficulty in fulfilling these conditions. All injectors with fixed nozzles work best at one steam pressure, and although a considerable range is admissible, both above and below this point, at no other higher pressure will they operate as efficiently; with injectors having two sets of steam nozzles, this range is much more extended than with the single-jet type.

The principal feature that interests railroad men is the falling off in the delivery of an injector which occurs at the higher steam pressures, and the usual necessity of purchasing a larger size instrument to obtain the required number of gallons per hour, resulting in an increased consumption of steam and a larger financial outlay. If, on the other hand, an attempt is made by the manufacturer to increase the capacity of the fixed-nozzle injector, by enlarging the area of the water entrance to the combining tube, the action of the injector at low pressures is rendered very uncertain.

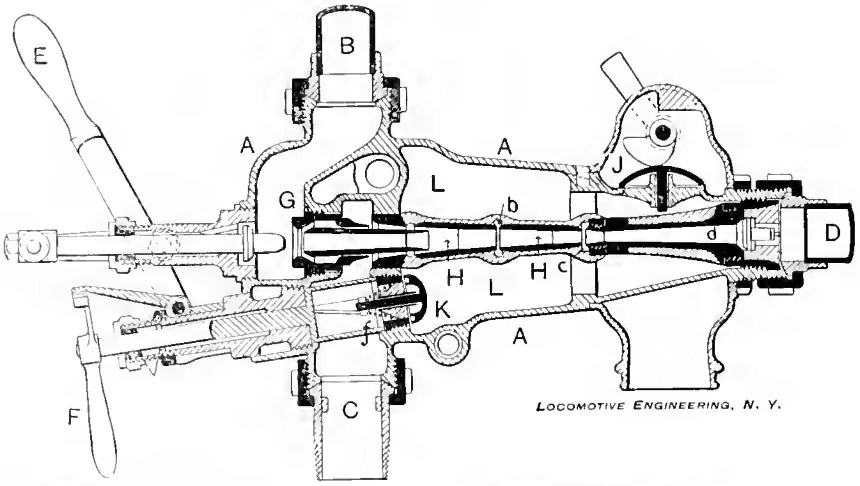
There is little doubt but that the injectors of the adjustable or self-adjusting types and those provided with a lifting and forcing steam nozzle, are best suited for high steam and wide ranges of pressure. To this latter class belongs the well-known Sellers' injector of 1887, which differs from others of its class in having an open overflow to permit restarting, yet automatically adjusting its water supply to suit all changes in the steam pressure without waste.

To this injector have been added certain improvements embodied in a patent recently granted to Strickland L. Kneass, of Philadelphia, which still further increase the range at the higher steam pressures without complicating the construction of the instrument or altering the design or shape of the body, or any of the proportions of the tubes. The maximum capacity of the improved instrument when placed one foot above the level of the water supply is, at 210 pounds steam, 2,625; the number of gallons per hour delivered by the injector increases up to this pressure, and only commences to fall off after the steam is raised much above this point. This fully meets the requirements of the modern high-pressure compound locomotives, because the actual efficiency of this injector, as measured by the number of pounds of water delivered per pound of steam, has been very much increased, and that without sacrificing in any way its performance at the lowest steam pressures.

A sectional view of this injector is shown in the accompanying figure. *A* is the body or casing, *B* the steam branch, *C* the water branch, and *D* the branch for the boiler pipe. *E* is the starting lever for admitting steam to the nozzles, and *F* the water-regulating handle for adjusting the valve *f* to suit the needs of the boiler. *G* is the double steam nozzle, the outer nozzle lifting the feed water and supplying it to the second or forcing jet. *H* is the combining tube for the forcing steam nozzle, and is provided with openings *b* and *c*. *K* is the new inlet valve, to which we call attention, for admitting a supplemental supply of water to the overflow chamber, and which automatically closes whenever the pressure in the overflow chamber is greater than that in the suction pipe, as is always the case when the starting lever is drawn for the purpose of priming. The object of this valve is to provide communication between the feed supply and the overflow chamber whenever the usual water entrance to the combining tube is insufficient to admit the necessary weight of water to completely condense the increased steam discharge at the higher steam pressures.

The effect of an insufficient water supply for an injector is to form a strong vacuum within the overflow chamber. In this injector this vacuum is utilized to augment the capacity, by holding down more strongly the overflow valve *J* and opening the inlet valve *K*, thus drawing a supplemental supply of water from the suction pipe which floods the overflow chamber *L* and enters the combining tube by means of the ports *a* and *b*, passing through the delivery tube *d* with the jet into the boiler. The resultant increase in capacity of a No. $8\frac{1}{2}$ injector at 180 pounds steam when lifting the water five feet is 24 per cent., while at pressures below 120 pounds the action is less remarkable.

Another characteristic of this injector which is of special value to those Western and Southern railroads which are troubled



Capacity.	Steam Pressures.						
	30.	60.	90.	120.	150.	180.	210
Cubic feet per hour	168	221	264	296	326	342	350
Gallons per hour	1,260	1,657	1,980	2,220	2,445	2,565	2,625

with the formation of scale on the tubes of the injectors, is the unusual length of time that it will operate without requiring an acid bath. This was shown conclusively by a comparative test made upon one of the largest Western roads; the average length of service of one of the best-known patterns of injectors on a locomotive was seven days, and of another pattern twenty-five days, while the injector we have described ran three months and twenty-six days continuously, without attention. A record of a somewhat different kind, but also interesting, as it tends to show the wearing qualities, is a continuous run of 500,000 miles over one of the lines running out of Chicago, which was made without grinding the valves or removing the injector from the engine.

A test of the capacity of an injector of this pattern, size No. $8\frac{1}{2}$, lifting the water supply one foot, gave the following results, which show the gradual increase of the capacity with the steam pressure and which prove it to be admirably adapted to modern high-pressure locomotive service.

LOCOMOTIVE ENGINEERING

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Railroads as Manufacturers.

A few months ago there was considerable joking heard among railroad men, on account of a statement made in a published report, to the effect that a certain railroad company, having been seized by the embarrassments of the hard times, proceeded to convert Krupp tires into hard hammers, with a humiliating result. The hammers made in the railroad shop cost them $8.98 per dozen, and they discovered that they could purchase better hammers for $4.50 per dozen. The head of the mechanical department which went through this experience reported that he discontinued the manufacture of hammers.

It seems to us that the man who figured as principal in this transaction deserved a great deal of credit—much more than those who talked about the incident were inclined to give him. To be sure, he departed from traditional methods, and a man who does that is certain to have his practices misrepresented. If he had followed the well-worn groove of railroad practice, he would have made no investigation into the cost of the hammers made in his shop but would have represented that the hammers cost practically nothing, as made in the shop, and that the company was reaping a golden harvest by the practice he had adopted of converting scrap material into useful articles. We have been shown machine tools and other expensive articles of home manufacture which were alleged to have cost the company nothing, because they were made in the shop.

When the head of the mechanical department of a railroad finds his requisitions for necessary tools and material cut down till he scarcely knows how to keep the shops running, there is a great temptation to enter into home manufacture, no matter at what cost; but it may be posted up as a true axiom that articles manufactured in a railroad shop cost more than what they can be purchased for. Railroad companies have not been the only sufferers from the hard times, and they are not the only concerns that have displayed a willingness to do work without profit in order to keep their staff together. Nearly every manufacturer has been in the same situation, and nearly every one has been ready to sell his product at cost. No man familiar with manufacturing operations will pretend that any railroad shop in the country can manufacture any class of shop tools as cheaply as they are made in establishments where special tools are in use to facilitate every operation. This being admitted, every ordinary home-made tool is a source of useless expense to the company which paid the bill.

The writer lately met with two incidents that gave curious illustrations of the impressions about home manufactures. He found in one railroad shop a number of pneumatic hoists in course of construction, and asked the master mechanic in charge if he could not buy the hoists for less than it cost him to make them. "Certainly," he replied, "but I have made requisitions for them several times, and they have been turned down as something we can do without. Now, I am kept so short of help that I am compelled to make these hoists to save labor, and I don't care what they cost." The other was the president of a railroad which was reported to be about to build a lot of locomotives for themselves in their own shop. The scribe asked the president if the report was true, and he said his road was too poor to indulge in any luxury of that sort. "We feel," he added, "like a well-known manufacturing concern that do not make their own castings. When the head of the concern was asked why they did not make their own castings, and save the profit made by the people running the foundry, he replied, 'Our business is making pumps, and all our energy and ability are devoted to making good pumps. We cannot spread ourselves thin enough to learn the foundry business. We must have good castings, and we are willing to pay a fair price for them, and it would not pay us to take the chances of failure.' "

Since the railroad men who attended the Railway Congress in London returned, we have heard several of them talk with admiration about the manufacturing plants at Horwich, Crewe, St. Rollox, and other places in Great Britain, with a sigh that seemed to say, "How great our road would be if we had a plant of that kind!" We are in possession of figures that indicate at what cost the manufacturing establishments of railroads in Europe are operated, and they show conclusively that American railroad companies have been fortunate in the policy that has become fashionable of purchasing tools and rolling stock in the open market. If a shop filled with ancient tools, with no developed system of economical production, can compete with another equipped with the best-known tools, operated by specialists who have spent years developing skill that reduces the cost of manufacture to its lowest terms, then railroad shops can afford to make their own shop tools and build their own locomotives and cars. The best-equipped railroad shop on the American continent is that belonging to the Pennsylvania Railroad at Juniata, Pa. If there is any railroad shop in a position to compete with private builders of locomotives it is that one, but it is certain that the railroad company would have saved money if they had never built those shops, but had continued the policy of purchasing their locomotives in the open market.

The hard times have started not a few railroad shops into the building of locomotives and cars, on the same policy as that pursued by the master mechanic who was making his own pneumatic hoists. When railroad shops build locomotives and cars, or even machine tools, that the skilled workmen may be kept at hand for better times, the policy is good, even when the products cost more than they could be purchased for; but when a railroad company begins to make a business of building its own rolling stock as a regular thing, it is throwing away the money of the stockholders.

Cracking of Firebox Sheets.

The cracking of firebox sheets of locomotives is such a serious matter that anything calculated to reduce this evil appears to be well worthy of a trial. There were some very good suggestions made regarding this matter in the course of a private letter received lately from a most intelligent master mechanic of wide experience. He said: "In looking over your August issue, the cracked firebox sheets of the Long Island Railway took my attention, although I may say that cracking of that kind is by no means uncommon on Western roads. As a rule, most of the cracking in firebox sheets that I have seen takes place between the stay-bolts above the fire line in the straight part of the firebox. In most cases the cracks are vertical and very seldom horizontal. I have put in sheets the way they were rolled vertically in a firebox, and I have put them in longitudinally, as they were rolled, thinking this might have something to do with the cracking, but it made no difference, both cracked alike. It has now occurred to me that the locating of the stay-bolt in vertical lines

might be, to some extent, the cause of the cracking which is so common. I think, perhaps, if the stay-bolts were stepped vertically, say $1\frac{1}{4}$ inches of a step, a great deal of the cracking might be avoided. Having them in line horizontally is all right; little or no trouble comes in that direction. My reason for thinking so is the rapidity with which the water and the steam flow to the surface, and the violent heat on straight part of side sheet and lower part of flue and door sheet. The water and steam are forced upward at such a velocity that the stay-bolts split the current all the way, and cause a difference in temperature. That alone, with the punching and drilling of the stay-bolt holes, the riveting of stay-bolts and sounding them at intervals, all causes a weakening and wedging process in one direction, and cracking commences.

"The reason they do not crack horizontally, as they do vertically, is that a clear space is open for the water to pass between the stay-bolts, which keeps the sheet in that direction at an even temperature. By stepping the vertical rows, this would give, in a sense, a clear space and even temperature. I think this would obviate a great deal of the present trouble with cracked side sheets. There would be no occasion to step them in the circular part of the box. They never crack there. With steel of a poor quality nothing will prevent cracking, and the sheets will give way in all directions. I have had, however, trouble with fireboxes cracking with the best steel we could buy."

Confusion About Legal Height of Drawbars.

When persons not familiar with details of machinery undertake to make rules or laws concerning the operation of the same, they are almost certain to commit errors which are annoying and cause confusion. At the first glance, it seems that men of ordinary intelligence, clothed with authority to establish a standard height of drawbar for railroad cars, could not possibly make their intentions so uncertain as to lead to confusion about what the average height should be, but there is no doubt that they have done so. The Safety Appliance Act of Congress, passed in 1893, authorized the American Railway Association to designate the standard height of drawbars, and to fix a maximum variation from such standard height to be allowed between empty and loaded cars. The American Railway Association then sent out a circular specifying $34\frac{1}{2}$ inches as the standard height of drawbars, and allowing 3 inches as a maximum of variation. When this settlement of the height was made, we supposed that $34\frac{1}{2}$ inches would be the average height, and that the 3 inches variation would permit drawbars varying from 33 inches as minimum and 36 inches as maximum height to be used. The members of the Master Car Builders' Association, however, looked at the case from a different standpoint. At the last convention a long discussion arose on the meaning of the circular issued by the American Railway Association, and after much conflict of opinion was expressed, a resolution was passed to the effect that it was the understanding of the Master Car Builders' Association that $34\frac{1}{2}$ inches was intended as the maximum height, and that $31\frac{1}{2}$ inches was intended as the minimum height.

When the case had advanced that far towards a rational settlement, it was natural to suppose that the Master Car Builders' Association would have placed the force of its collective opinion in the letter ballot, establishing the height of the drawbar as a standard of the association. But this aid to uniformity was not given. The letter ballot said "that the standard height of drawbars is to be $34\frac{1}{2}$ inches," and that the maximum variation allowed is 3 inches. Not a word about a minimum height. The consequence is that the head of the mechanical department of any railroad is at liberty to interpret the law for himself. The drawbars have all to be brought to the standard height not later than February 15th next, but the indications are that there will be considerable variation, and that still the claim may be made that diverse heights adopted are legal.

Although the words of the American Railway Association's circular would seem to indicate that $34\frac{1}{2}$ inches was to be the average height, with a variation of $1\frac{1}{2}$ inches above or below, the Master Car Builders adopted a resolution making $34\frac{1}{2}$ inches the maximum and $31\frac{1}{2}$ inches the minimum height, and the members ought to be guided by that. Nearly all practical considerations favor the starting from a maximum height, as the tendency of wear, straining and loosening of parts is to permit the drawbar to drop lower down. We believe that the companies changing the height of their car drawbars to conform with the law will be wise to make $34\frac{1}{2}$ inches the maximum, for by far the majority of railroads are adopting that as the meaning of the law. When an interpretation of the law is secured from Congress it is almost certain that the majority will be favored.

BOOK REVIEW.

COMPRESSED AIR. Practical Information upon Air Compression and the Transmission and Application of Compressed Air. By Frank Richards. John Wiley & Sons, New York. Price, $1.50.

This is one of the best books turned out for the benefit of mechanics in some time. It is practically the only work on the subject. Mr. Richards is particularly fitted to write such a work, having been for years employed in the manufacture of air compressors and air-using apparatus. The work is written in very plain language, perfectly intelligible to the average mechanic. The author tells the honest truth about the air-compressing business, and shows up the faults as well as the good points of each style of compressor in use. He points out the uses of air and its limitations, and also where it has not had a fair show. To anyone in any way concerned in the compression or use of air for commercial purposes, it is worth many times its price, especially to railroad shop managers, where more air is used than anywhere else in this country.

We give herewith the titles of the different chapters, which will go a long way toward showing what ground is covered:

Mechanical versus Commercial Economy; Definitions and General Information; A Table for Air-Compression Computations; The Compressed-Air Problem; The Indicator on the Air Compressor; The Beginning of Economical Air Compression; Of Compression in a Single Cylinder; Two-Stage Air Compression; Two-Stage Compression, Single-Acting, Tandem, etc.; The Power Cost of Compressed Air; The Power Value of Compressed Air; Compressed-Air Transmission; The Up-to-Date Air Compressor; Compressed Air versus Electricity; The Thermal Relations of Air and Water; The Freezing Up of Compressed Air; Reheating Compressed Air; Compressed Air for Pumping; The Various Applications of Compressed Air.

Some remarks made by Mr. Geo. W. West, at the last meeting of the Central Railroad Club, concerning the framing of rules for the guidance of the men handling car-heating apparatus, are well worthy of attention and of extended application. A report had been submitted containing very elaborate instructions to trainmen and other employés. Mr. West took the stand that the instructions ought to be simplified and put in as small compass as possible. The same fault can justly be found with nearly all rules, regulations and codes of instructions issued to all classes of railroad men. Those who prepare that kind of literature seem to start out with the assumption that the men to be instructed are idiots devoid of common sense, and so details are elaborated which excite derision on the part of the practical reader, and incline him to throw the instructions aside as worthless. It is always a good plan to treat men as if they were rational, thinking beings. Those who do this are the most successful in teaching trainmen the proper way to take care of train mechanism.

In the course of a discussion at the Western Railway Club on "Exhaust Pipes and Steam Passages," Professor Warren, of the engineering department of the Sydney University, of New South Wales, made a statement to the effect that the English locomotives used on the railways of New South Wales are much more economical than the American engines. He asserted that under test an English engine hauled a heavier load at a higher speed than that maintained by the American locomotive, and that the fuel consumed by the English engine was 55 pounds per train mile, while the American engine used 75 pounds per train mile. Mr. C. F. Street, who lately visited Australia, said that the American engines handle the trains much easier than those of English make, but he regretted to say that they do not make a good comparison when fuel economy is considered.

PERSONAL.

Mr. John Turner has been appointed car foreman of the Michigan Central at Toledo, O.

Mr. Arthur Monnon has been appointed general manager of the Monterey & Mexican Gulf.

Mr. P. J. Maguire has been appointed master car builder of the Southern Pacific, with headquarters at Algiers, La.

Mr. George Kuhns, a passenger conductor on the Chicago & Northwestern, has been appointed trainmaster of that road at Madison, Wis.

Mr. Wm. Trumby has resigned the position of superintendent of the Pittsburgh & Western to accept charge of the Ohio & Fairpoint terminals.

Mr. B. W. Fenton, formerly chief engineer of the Findlay, Fort Wayne & Western, has been appointed chief engineer of the Ohio Southern.

Mr. George L. Bradbury, general manager of the Lake Erie & Western, has also been chosen vice-president of the Cleveland, Akron & Columbus.

Mr. W. F. Dixon, chief draughtsman of the Rogers Locomotive Company, has resigned that position and sailed for Europe on October 16th for a six weeks' trip.

Mr. Henry Wood, manager of the South Jersey, has been appointed general manager of the Choctaw, Oklahoma & Gulf, with headquarters at South McAlester.

Mr. H. D. Taylor, engineer of tests of the Lehigh Valley, has been appointed mechanical engineer of the same system, with headquarters at South Easton, Pa.

Mr. J. J. Ryan, general master mechanic of the Atlantic system of the Southern Pacific, has been appointed superintendent of motive power of the same system, with headquarters at Houston, Tex.

Mr. W. M. Patton, formerly chief engineer of the Mobile & Birmingham, has been appointed professor of civil engineering at the Virginia Agricultural and Mechanical College at Blacksburg, Va.

Mr. O. H. Jackson has been appointed master mechanic of the Santa Fé, Prescott & Phœnix Railway at Prescott, A. T. Mr. Jackson was for several years in charge of the Big Four shops at Brightwood, Ind.

Mr. J. A. Fillmore, who has long been general superintendent of the Central Pacific, has been made manager of the Pacific system, under a revised organization effected by General Manager Kruttschnitt.

Mr. A. E. Reed, superintendent of the Lewistown division of the Pennsylvania Railroad, has been appointed superintendent of the Shamokin division of the Northern Central, with headquarters at Sunbury, Pa.

The office of Mr. W. T. Reed, superintendent of motive power of the Seaboard Air Line, which was temporarily located at Raleigh, N. C., has been removed to the official headquarters of the road at Portsmouth, Va.

Mr. George W. Creighton, superintendent of the Shamokin division of the Northern Central, has been appointed superintendent of the Middle division of the Pennsylvania Railroad, with headquarters at Harrisburg, Pa.

Mr. R. O. Cumback, who has been lately employed in the Illinois Central shops at Burnside, Ill., has been appointed general foreman of the same company's shops at Clinton, Ill. He formerly held the same position at Clinton.

Mr. W. R. Mansfield has been appointed general superintendent of the Carthagenia & Magdalena, with headquarters at Carthagenia, Republic of Columbia, South America. He was for several years a conductor on the Mexican National Railway.

Mr. W. D. Campbell has been appointed trainmaster of the Akron division of the Baltimore & Ohio, with headquarters at Newark, O., in place of Mr. H. O. Dunkle, resigned. Mr. E. M. Rine has been appointed chief dispatcher of the same division.

It is reported that Mr. S. R. Callaway, president of the New York, Chicago & St. Louis, was offered the position of general manager of the Grand Trunk, with a substantial advance of salary. He decided, however, to hold on to his Vanderbilt connection.

Mr. H. B. Hodges has been appointed superintendent of tests of the Southern Railway, with headquarters at Washington, D. C. He has held the position of engineer of tests of the Baltimore & Ohio, and resigned to accept the higher position on the Southern.

Col. H. S. Haines, president of the American Railway Association, and long connected with the Plant Railroad system, has been elected chairman of the Southern States Freight Association, and will devote all his time to work connected with that organization.

Mr. J. R. Cade, heretofore general foreman of car department at Houston, has been appointed master car builder of the Galveston, Harrisburg & San Antonio and Texas & New Orleans roads of the Southern Pacific system, with headquarters at Houston, Tex.

Mr. J. T. Mahl has been appointed engineer of maintenance of way of the Texas lines of the Southern Pacific. For several years he has been assisting General Manager Kruttschnitt. He is a son of Mr. W. T. Mahl, New York assistant to President Huntington.

Mr. George Royal has been made general Western agent for the Nathan Manufacturing Company, which entails increase of duties and of responsibilities. Mr. Royal is one of the best-known of the railroad supply fraternity, and his numerous friends will be gratified to learn about his advancement.

Mr. C. S. Falconer has been appointed road foreman of engines on the Greenbrier and New River districts of the Chesapeake & Ohio Railroad, to succeed Mr. I. H. Brown, resigned. Mr. Falconer has been until recently chief engineer of Division 101, B. of L. E. The men are very much pleased at his promotion.

Mr. Thornwell Fay has been appointed manager's assistant of the Atlantic system of the Southern Pacific, with headquarters at New Orleans, La. He has heretofore been chief clerk to General Manager Kruttschnitt. He will have jurisdiction over the company's terminals at New Orleans, Algiers and Gretna.

Mr. M. J. Drury, for several years foreman of the Atchison, Topeka & Santa Fé at La Junta, Colo., has been appointed general foreman of the new shops built by the company at Arkansas City. Mr. Drury is one of the ablest men in his line, keeps particularly well posted on mechanical matters, and we wish him success in his new shops.

Mr. W. G. Van Vleck has been appointed general manager of the Atlantic lines of the Southern Pacific system, in place of Mr. J. Kruttschnitt. Mr. Van Vleck has been general superintendent of these lines for six years. He was for some time with the Grand Rapids & Indiana, and later with the Galveston, Harrisburg & San Antonio.

Mr. J. P. McCuen, who has been for several years a master mechanic on different divisions of the Queen & Crescent, and has lately been in charge of the shops at Ludlow, Ky., has been appointed superintendent of motive power of the Cincinnati, New Orleans & Pacific, with headquarters at Cincinnati. He will remain in charge of the shops at Ludlow.

Mr. H. Wade Hibbard, who has been for some time chief draughtsman of the Lehigh Valley, has left railroading to become professor of mechanical engineering of the Minnesota University, at Minneapolis, Minn. Mr. Hibbard attracted the attention of railroad mechanical men by the remarks he made on "Boilers" at the last Master Mechanics' Convention.

In our last issue we mentioned that Mr. J. F. Sheahan, formerly of the Orange Belt, had been appointed general foreman of the Plant system shops at Palatka, Fla. This was not entirely correct, as Mr. Sheahan has been appointed master mechanic of the Florida Southern, Sanford and St. Petersburg railroads of the Plant system, with headquarters at Palatka, Fla.

Mr. C. M. Mendenhall, superintendent of motive power of the P., W. & B., was recently waited upon by a committee representing the engineers of the New York division of the Pennsylvania road, and presented with a handsomely engrossed and framed set of resolutions. Mr. Mendenhall endeared himself to the enginemen while assistant

to the superintendent of motive power of the New York division.

Mr. Nat Sawyer, the veteran locomotive engineer of the New York Central, has been appointed engine dispatcher at Seventy-second street, New York, in place of Mr. J. C. Cameron, resigned. Many of our readers will associate Mr. Sawyer with engine "999," which he had charge of at the World's Fair, and which he took great pleasure in praising to the numerous railroad men who visited the Fair.

Mr. W. A. Vaughan has been appointed assistant general superintendent of the Southern Railway, with headquarters at Chattanooga, Tenn. He will have full charge of all transportation matters pertaining to the Fourth and Seventh operating divisions. Since the reorganization of the Southern system Mr. Vaughan has been superintendent of the car service, and before that was general superintendent of the East Tennessee, Virginia & Georgia.

Another good railroad man has been tempted away by a manufacturing concern. Mr. H. D. Gordon, superintendent of the Juniata shops of the Pennsylvania Railroad, has resigned to become superintendent of the Jenkins Brothers' Works, New York. Mr. Gordon and the senior member of the firm he is going with have been intimate friends since they were boys, and the position now accepted has been urged upon Mr. Gordon annually for fifteen years.

Mr. Joseph Ramsay, Jr., has been appointed general manager of the Wabash, to succeed Mr. Hays. Mr. Ramsay is now general manager of the Terminal Railroad Association of St. Louis, and will not make the change until the beginning of the year. Mr. Ramsay is 45 years old and has risen through the engineering department, the first years of his professional work having been spent on connections of the Pennsylvania system. Then he was chief engineer of the Cincinnati, Hamilton & Dayton, and left there to be general manager of the Big Four.

Announcement has been made by President Huntington, of the Southern Pacific system, that Mr. Julius Kruttschnitt has been appointed general manager of the Pacific system, with headquarters at San Francisco, Cal. For the last six years Mr. Kruttschnitt has been vice-president and general manager of the Atlantic lines of the Southern Pacific, and his excellent management in that position commended him for the more important one on the Pacific Coast. He rose through the engineering department, and was engaged in engineering work on various Southern roads up to 1883, when he was appointed chief engineer and superintendent of Morgan's Louisiana & Texas Railroad & Steamship Co. From that time his upward progress has been very rapid.

Mr. Chas. M. Hays has been appointed general manager of the Grand Trunk Railway. This is one of the greatest surprises that has come to railroad circles in several years back. The Grand Trunk Railway Co. have generally followed a policy that put English railway men in control as leading officers, and the appointment of Mr. Hays appears to be an indication that the company desires to adopt the business methods which have made American railways much more prosperous than those of Canada. Mr. Hays is a comparatively young man, but he has acquired a most enviable reputation for his able management of the Wabash system, a most difficult property to run economically. The greater part of Mr. Hays' railroad experience has been obtained on the Wabash, but he had before going there about eleven years' experience on various Western roads. He is a pleasant, genial man, and has been highly popular with high and low on the railroads where he was employed. The officials and others on the Grand Trunk route have looked with some apprehension on the advent of a Yankee as their general manager, but we feel moved to assure them that every man who intends to do the right thing towards the company he works for will find a good friend in Mr. Hays.

We are in receipt of a long letter from the engineer who ran the Holman engine —the monstrosity with friction wheels and trucks under her drivers—in which he claims we have done the inventor an injustice. He claims there are not so many wheels and axles as we counted in the picture, but admits ten extra axles and twenty extra wheels. The writer claims to have run the Holman engine on bad track, from dead stop to dead stop, one mile in sixty seconds, and to have started, reached eighty miles per hour, and come to a dead stop again in 1 mile and 220 feet—all of which is important, if true. The writer says the Holman engine gains power after starting, yet it multiplies the speed—great engine that! If this engine can do all this it proves that the fundamental laws of mechanics are wrong, and that adding to the length of a lever does not increase the power. We think our correspondent is over-enthusiastic—can't prove his claims.

The *American Engineer and Railroad Journal* is going to "split the difference" between a monthly and a weekly, and come out bi-weekly hereafter. The reading matter will be cut down to half the amount now given. We wish Brother Forney success, but we miss our guess if he don't waste more time, breath and ink in explaining that his paper is neither a weekly nor a monthly than the whole change is worth—the writer once owned a tri-weekly paper. The *American Engineer* claims to be the oldest railroad paper in the world, and as it has always been a monthly it behooves the other monthlies to bid it a God-speed in its new venture. So here's a health to the oldest monthly railroad paper —the *American Engineer*—from the best —LOCOMOTIVE ENGINEERING.

The Springfield Shops of the B & A.

The new shops of the Boston & Albany, at Springfield, Mass., are now in full operation. They are very neat and fairly well arranged shops, but could have been doubled in capacity by a twenty-five per cent. increase of size of the main shops.

The wood and coach shop occupy one side, along a huge transfer table pit; the machine shop, erecting shop, blacksmith and boiler shops the other side.

At one end of the transfer table pit stands the power house. The boilers are fired with fuel oil. The main engine rests on a pier, around which, below the floor, there is a pump room. The shops are heated by the Sturtevant system of hot air, the apparatus occupying a room just off the main engine room. In this building there are also lavatories, closets, etc.

In the machine shop end of the main building there is a gallery on each side; one side is occupied by the offices and light tools, the other by heavier tools, the link work and other light parts being put in shape here.

The shop is well supplied by new tools and modern ones. There are enough tools to do all the machine work on 300 locomotives.

One cannot help but notice the absence of the long rows of lathes, so noticeable in shops equipped from ten to twenty years ago. Special tools, boring and turning mills, millers, etc., do the work now cheaper and better.

The tools are so located as to avoid rehandling of materials, and they are getting in overhead tracks and air-lifts very fast, wheel lathes, etc., being supplied now, a Pedrick & Ayer compressor furnishing the wind.

The wheel lathes, axle lathes and hydraulic presses are located at the ends of the pits; between them and the pits runs a track, and below this track they have arranged air cylinders that will send a ram up through the floor by the touch of a valve on a post. Swiveling V-heads are used on these piston rods to take hold of the centers of axles when pairs of mounted wheels are on this track. Wheels can be raised up and turned around to roll to any machine or track; this is much neater than turntables.

Ordinary tender cylinders are used for this work—one for truck wheels, and two of the same for lifting driving wheels.

They have a first-class drop pit, which is, after all is said and done, about the best thing out for a repair shop—it wants to be a mighty big repair shop that needs a crane.

They use this pit for other purposes than dismounting engines. When a carload of wheels arrive they put the car on the drop table, lower it to a level with the floor and roll the wheels off—they do not pull off old wheels until they have enough for a carload—then they bring in a flat car, drop it, and load the wheels as they are pressed off—this saves handling.

Master Mechanic Thos. B. Purves, Jr., does not believe in keeping scrap about. His scrap bins are on a flat car, and when there is a load he ships it away and sets another car in its place.

The tools in the machine shop are almost all new; those in the wood shop are the old tools from the old shops.

The paint shop has cement floors, but no means of lifting coaches except jacks—and jacks and cement floors are bad friends.

The transfer table is an electric affair, designed by the bridge department. The bridge is enormously strong, and the whole thing is carried on two lines of rails 60 feet apart. The power is electricity. This table has a great depth of truss, and the bridge and the driving gears come to within 3 or 4 inches of the bottom of a very deep pit. If they do not have a continual round of pleasure with that affair when the snows come, I miss my guess. If the bridge was turned over or could be mounted on high wheels, it might save lots of grief. The entire shops are lighted by electricity, and they have been liberal with their lights—they are lighted far above the average.

The repair yard for freight cars is large and well located for handling material and cars.

The yards are clean and neat, and, taken altogether, Mr. Taft, the head of the motive-power department of the road, is to be congratulated on the shop and the way they have worn the new off.

It would be unfair to give the credit for the improvements to anyone except T. B. Purves, Jr. He is the presiding genius, and slowly and surely plans out his methods for saving time and money, and then puts them into force. The air plant of this shop alone, with the exception of the compressor, home-made, will save the salary of any master mechanic.

There is nothing so very remarkable about the Springfield shops of the B. & A., but I wish every railroad in New England had one as good. I have never heard of a better up in that neck o' woods.

J. A. H.

The offices of the Latrobe Steel Works have been removed from Latrobe, Pa., and from the Bullitt Building, Philadelphia, Pa., to the Girard Building, Broad and Chestnut streets, Philadelphia. The business of the company has been growing quite rapidly of late, and it has been considered desirable to consolidate the offices.

The Standard Paint Co., of this city, have issued a very interesting catalogue on paints for railroad work, brick-work, buildings, piling, etc. They make a pile covering that resists all marine animals, such as the destructive teredo.

The B. & A. are working ten hours with a 25 per cent. increase of men in their freight repair department, at Springfield, Mass.

EQUIPMENT NOTES.

The Ann Arbor are in the market for 700 box and twenty-five furniture cars.

The Lehigh Valley are about to place orders for a large number of freight cars.

The Swift Co., of Chicago, are preparing specifications for some new Refrigerators.

The Chicago & Northwestern have ordered fifteen locomotives from Schenectady.

The Buffalo, Rochester & Pittsburgh are getting out specifications for a new lot of coal cars.

The C., B. & Q. are reported to have ordered 2,000 cars from the Wells-French Company.

The Juniata shops of the Pennsylvania Railroad are building twenty-five Class P locomotives.

The Chicago, Milwaukee & St. Paul are building 800 freight cars in their shops at West Milwaukee.

The Central R.R. of New Jersey have sent out invitations for bids on 500 coal cars with King drop bottoms.

The Erie have ordered 1,000 freight cars. All of them have Westinghouse air brake and M. C. B. couplers specified.

The Seaboard Air Line are contemplating the purchase of some new freight cars. Specifications are in course of preparation.

B., C. R. & Northern have given the Wells-French Co. an order for an additional 100 cars, same in all respects to their previous order of 100.

The Maine Central and the Michigan Central are both said to be in the market for 1,000 freight cars. The Norfolk & Western are about to order 100 hopper gondola cars.

Baldwins have received an order from the Lehigh Valley for twenty heavy ten-wheel freight engines, and one from the Chicago, Milwaukee & St. Paul for ten ten-wheel engines. The latter are all compounds.

The Russian Government have placed an order with the Baldwin Locomotive Works for forty locomotives. They will have Westinghouse air brakes and all the most approved appliances for convenience in operating.

Brooks people have received from the Ohio Southern an order for six locomotives. The former company have just shipped to the Mexican Central two ten-wheel passenger engines, with cylinders 20 x 24 inches.

The Rhode Island Locomotive Works have received an order from the Gulf & Interstate, of Texas, for two locomotives. They will have U. S. metallic packing, the Gollmar bell ringer and the unbreakable gage glass made by the U. S. Metallic Packing Co.

Among the latest rumors about the ordering of rolling stock are: The Pennsylvania people are about to increase their orders for new cars up to 5,000. The Atlantic Coast Line are about to order 1,500 cars. The Wheeling & Lake Erie are going to order 1,000 freight cars.

More Train Speed Record Breaking.

There has been so much record breaking since we wrote our account of the fast runs which appeared in LOCOMOTIVE ENGINEERING last month that it is difficult to tell where the laurels belong. The New York Central made extraordinary speed with its newspaper train, having covered the distance of 148 miles from Albany to Syracuse in 130 minutes, an average speed of 68 miles an hour.

The Lake Shore & Michigan Southern people, who have probably the finest track in the world for making a long-distance fast run, were moved to show that they were equal to the performance of their New York Central relative, and they started out a train from Chicago on October 24th to show what they could do. From the outskirts of Chicago to the yards in Buffalo, a distance of 510.1 miles, the run was made in 470 minutes and 20 seconds, an average speed, including stops, of 65.07 miles an hour. The train consisted of three cars and weighed, with engine and tender, 488,500 pounds.

An extraordinarily fast run was made over the Buffalo division, the distance of 86 miles from Erie to Buffalo having been passed over in 70 minutes and 16 seconds, an unexcelled speed for that distance of 73.43 miles an hour. This was done by a ten-wheel engine, with cylinders 17 x 24 inches, and driving-wheels 69 inches diameter. The other engines were all eight-wheelers of the type illustrated in LOCOMOTIVE ENGINEERING of July, 1893. They have cylinders 17 x 24 inches, driving-wheels 72 inches diameter. Steam pressure carried, 180 pounds. All the engines were built at the Brooks Locomotive Works.

By an oversight last month we neglected to mention the appearance of the report of the Master Car Builders' Association. The Twenty-ninth Annual Report is larger and better than any previous one, and Secretary Cloud has done a sensible thing in having it bound in plain cloth boards. It is worth binding, and most men intend to have the reports bound, but, alas, how many of them get mislaid or mutilated instead! Now the work is ready for the library and will be taken care of.

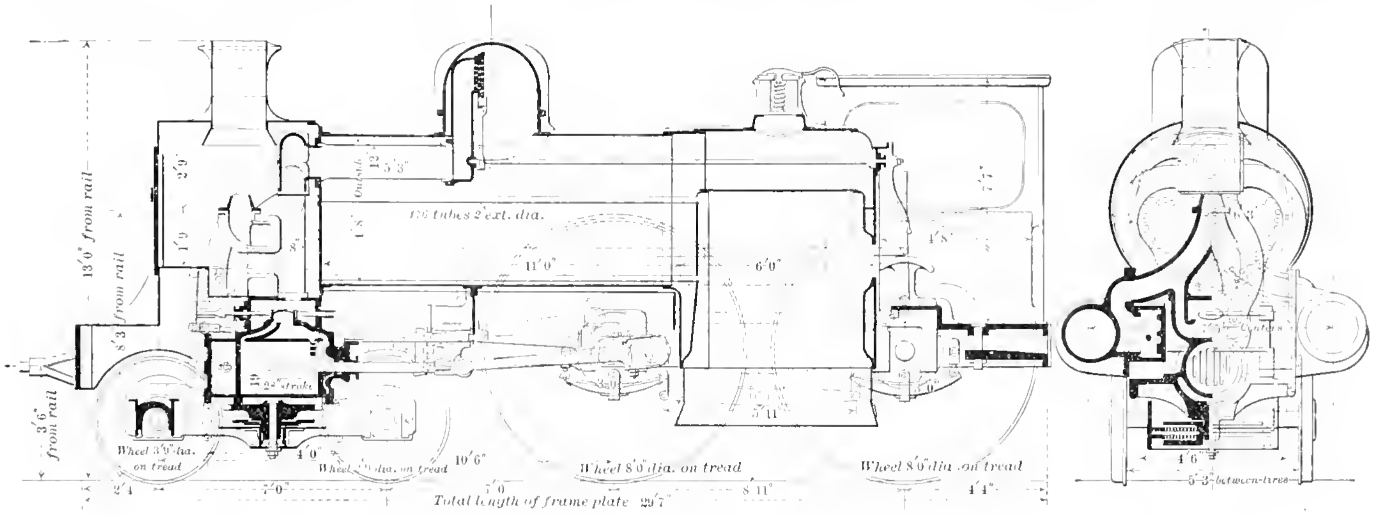
We direct the attention of intending manufacturers to the receiver's sale of real estate, buildings, machinery, etc., located in Albany, N. Y., particulars of which are given in our advertising columns. The establishment, with the tools, can be bought cheap, and they are admirably adapted to manufacturing purposes. Any concern wishing to get a good building and good tools cheap in a good location should look into this opportunity.

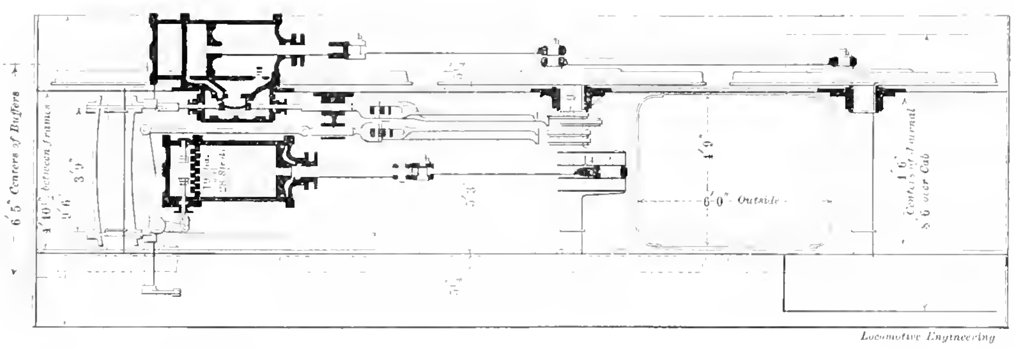
A Proposed High-Speed Engine.

Editors:

I am afraid Mr. Barnet Le Van would find his single-cylinder engine a very troublesome one if made.

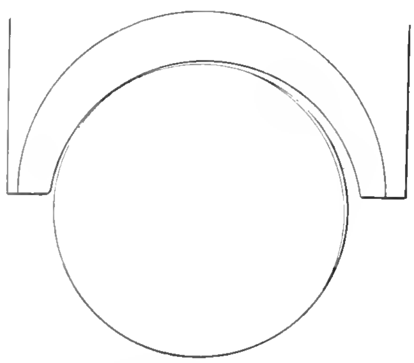
I send you a full-sized sketch taken from the templates of a driving journal and brass bearing, which shows the wear that takes place when a locomotive is put to heavy work. The engine has 18x26-inch cylinders and a boiler pressure of 160 pounds. Mr. Barnet Le Van will be able to form an idea of what is likely to take place with his proposed single-cylinder engine having 24x26-inch cylinder and 200 pounds boiler pressure. Moreover, the surging motion with such an engine would be very objectionable. Only part of this surging is felt in steamers with one cylinder, on account of slip. The locomotive would have the full benefit of surge if it did not slip. However, should such an engine ever be built, I would recommend the maker to arrange for the driving brasses to be made in segments, so that the thrust wear could be taken up every trip, if necessary.





Locomotive Engineering

The ugly wear and tear that exists in a locomotive induced me some nineteen years ago to study the matter carefully. I gradually came to the conclusion that the flat place worn in the tire was due entirely to slip and not to balance weights, and my practical experience with engines working on heavy grades confirms this. I also came to the conclusion that the wheel was turned by a succession of pulls at crank and axle. Take the crank on bottom—no amount of push at the crank-pin will cause the wheel to rotate forward. It will and does cause it to slip and gouge out the tire. The wheel must be held, fixed, at the crank-pin so that wheel can be pulled forward by the axle. I therefore consider that the fulcrum is ever changing from axle to crank-pin, so far as the work is done in the wheel, if such a term may be used. To overcome the wear and tear referred to, and to have a steady running high-speed locomotive, I patented an engine having a constant fulcrum. I send a print of the same. It will be noted the engine is single-acting. I use the crank-pin as a constant fulcrum when going forward, having a continuous pull on the axle. The connecting rod always being in compression, does away with knocking and pounding; also dispenses with balance weights. I would suggest 6-inch tires and no lead.



The engine is shown single-acting, but I have also arranged so that it could be worked double-acting to facilitate starting and grade-climbing, and convertible to single-acting when speed is attained.

As regards the compound locomotive, there is one at work in India, and there is every promise of it becoming the engine of the near future for obvious reasons. I am unable to send you a print of the same, but may do so later on.

Lahore.

JOHN RIEKIE,
District Locomotive Supt.,
Indian State Railways.

A Flue-Testing Machine.

Editors:

I am sending you herewith a sketch of a flue-testing machine in use at the Missouri Pacific shops, St. Louis, which I believe has some special merits of its own.

Our road has a great diversity in sizes and styles of locomotives, and the length of flues varies a great deal. The St. Louis shops safe-end and clean flues for most of the whole system. We ship away an average of 4,000 flues per month. Under these conditions it is important to save all the time and labor possible. Therefore we do not cut off the ragged end of the flue, but leave this to be cut off at the shop where the flue is used, to exactly the right length to suit the boiler in which it is to be set.

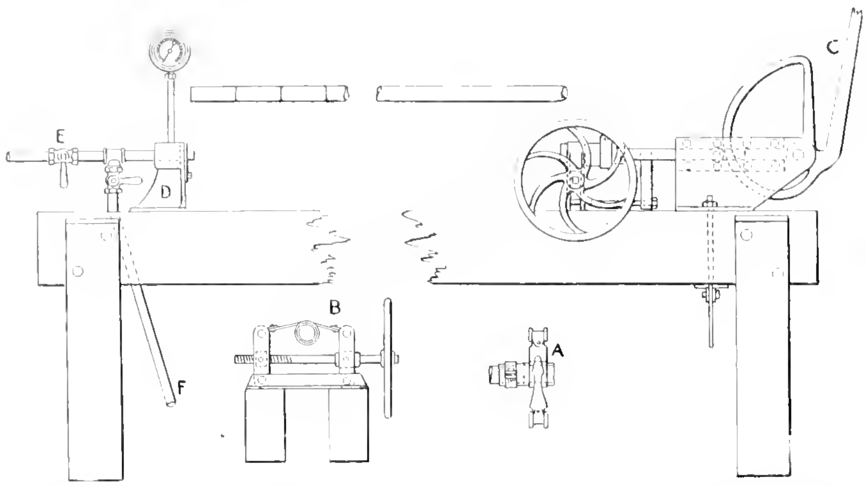
We test all our flues with from 80 to 90 pounds of steam, finding this much better than hydraulic testing. It is much quicker, and leaks are detected much easier. It is difficult to detect slight leaks with hydraulic pressure, especially if the flues are wet on the outside.

The apparatus will be easily understood from the sketch. *A* shows a clamp made out of sheet steel; *B* shows the method of drawing the clamp *A* tight around a piece of rubber hose, by which the hose is closed on the outside of the flue, making a steam-tight joint. This hose is large enough to insert the ragged end of the flue and make a joint in front of it. The other end of the flue, being square, on account of the new safe-end, slips over a nipple, in what may be termed the headstock of the device, marked *D*. By moving a lever, *C*, the clamp *B* can be moved 6 inches on the bed. This is used to force the clean end of the flue on the nipple and against a rubber ring, which makes a steam-tight joint. The cock *E* is then turned, admitting steam to the flue, and is as quickly exhausted by opening cock *F*.

Two men handle the machine; one of them takes the flue to be tested, passes an end to the man at the clamp, who inserts it in the rubber hose, screws up the clamp, and brings the lever down to tighten the other end, the man at the headstock having entered it on the nipple. He then turns on the steam, turns it off again, and the second man takes out the hot flue. They easily handle seventy flues per hour, becoming very expert at it in a short time.

The greatest saving made by this machine is in cutting off the flues, for in nine cases out of ten, where flues are sent away from shops where boiler is, this has to be done twice.

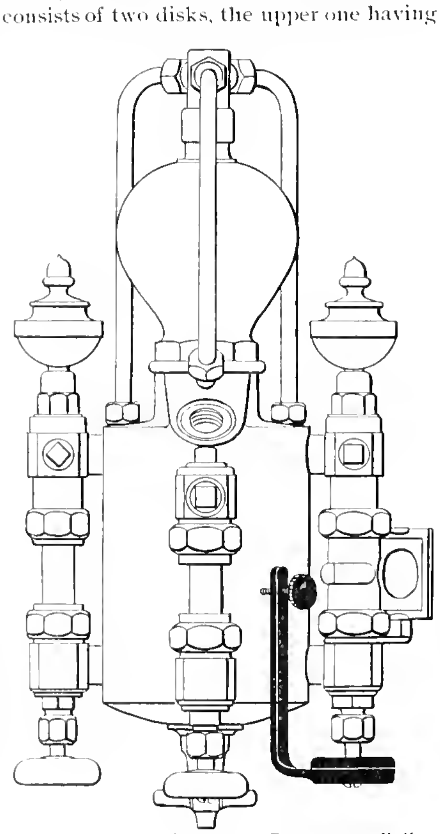
THOMAS FIELDEN,
St. Louis, Mo. General Foreman.



Handy Feed Set for Sight-Feed Lubricators.

Editors:

I send you sketch of an attachment for setting feed valves of lubricators, which consists of two disks, the upper one having



LOCOMOTIVE ENGINEERING, N. Y.

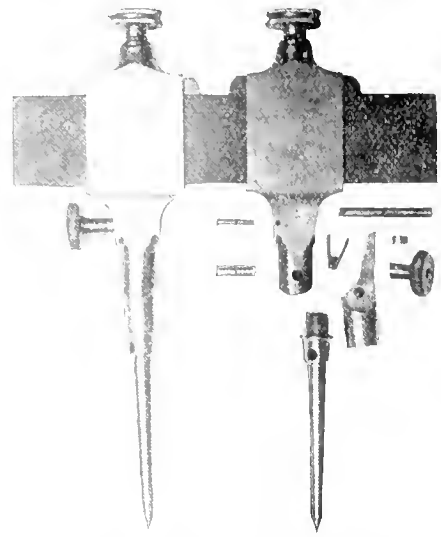
a square hole in it to fit end of stem, the lower one having an arm with a thumb-screw in end of it; the two disks are held together by the small screw passing through them and into the valve stem, thus allowing arm to be set at any angle, the thumb-screw in end of arm being for close setting. Once set and regulated, the feed can be shut off and returned to exactly the same place again in the dark as well as in the light. It's one of those handy little tricks only appreciated by men who have the constant care of a lubricator.

Argentine, Kan. GORDON MILLER.

An Adjustable Tram Point.

Editors:

I send you herewith a photograph of a pair of "trammel points" I have made for locomotive tramming, which I have had in



use for some time and find very durable and accurate, being easily and closely adjusted. The cut will show the construction better than any written description.

G. M. TOWER,
Foreman Loco. Dept. F. R. R.
Fitchburg, Mass.

The death is announced, under sad circumstances, at the age of 84, of Joseph Bell, who was the first railway engine-driver in England, having had charge of the old "Rocket," which is now on view in the South Kensington Museum. He was for 23 years driver of the South-Eastern Dover mail, and was for 17 years engaged by the District Railway Company. Three weeks ago, whilst walking along the road, he fell down the unprotected trap of a public-house, and sustained a fracture of the right hip, extensive bruising, and a severe scalp wound. He was taken to the Queen's Jubilee Hospital, and death took place from shock consequent on the injuries.—*London Times.*

The Siemens-Halske Company, of Chicago, have brought a suit against the Baltimore & Ohio Railroad Company for infringement of a patent belonging to the former company in connection with the operating of the heavy electric motors in the tunnel at Baltimore. The patent reported to be infringed is the peculiar form of trolley used for transmitting the electric current from the main conductors to the motor.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Comparative Trials of the Westinghouse Plain Automatic and Quick-Action Brakes in England.

Last May a series of brake trials was held on the Northeastern Railway of England, under the direction of Mr. Wilson Worsdell, locomotive, car and wagon superintendent of that line, to determine the comparative efficiency of the Westinghouse plain automatic and quick-action brakes. As this same ground was gone over in this country some time ago, the results of the trials, which have just reached us through the English technical papers, while not being very instructive, will be of interest, inasmuch as they inform us of what is being done in the air-brake line by the railroads on the other side of the water.

The quick-action brake apparatus used on the cars in these tests was not of the latest and most approved form, yet it was sufficiently effective to make a 21 per cent. shorter stop from a speed of 60 miles per hour than the plain automatic brakes. The braking power was surprisingly low and was distributed as follows :

Locomotive braked at 19.76 per cent.
Tender braked at 41.91 per cent.
Carriages braked at 70 per cent.

What follows is from *The Engineer :*

"We have selected [for the diagrams] the emergency stops which were made on the 29th of May at Acklington on a falling gradient of 1 in 280 with the quick-acting system, and the emergency stop with the ordinary brake at Alnmouth on a falling gradient 1 in 284. The former stop was a splendid stop in every way ; whereas in the latter, when the "ordinary" was used, the train broke in two. Fig 1. gives the diagram relating to the stop with the quick-acting brake, and Fig. 2 shows the action of the ordinary brake. The lines of the diagrams—Figs. 1 and 2—are marked for their different meanings. The moment the driver touches the handle of the brake valve an electric circuit is closed, and a pencil, worked by an electro-magnet, makes a notch in the line, showing the precise moment when the experiment begins, and showing the number of seconds the valve was kept open. In Fig. 1 the line of the pressure in the brake cylinder begins to rise about two seconds later, showing that the action of the brake had been transmitted from the engine to the rear van, a distance of 1,130 feet, in two seconds, and in less than four seconds the brake pressure was at its maximum. If we compare with this Fig. 2, we find that the pressure in the brake cylinder of the ordinary brake hardly asserts itself after four seconds, and does not reach its maximum before nearly twelve seconds have elapsed. This great rapidity of action of the quick-acting system explains why it should be able to stop a train in 100 yards less than the ordinary brake.

"The results of the trials have shown very clearly that, in these days of fast running and long trains, the quick-acting Westinghouse brake presents considerable

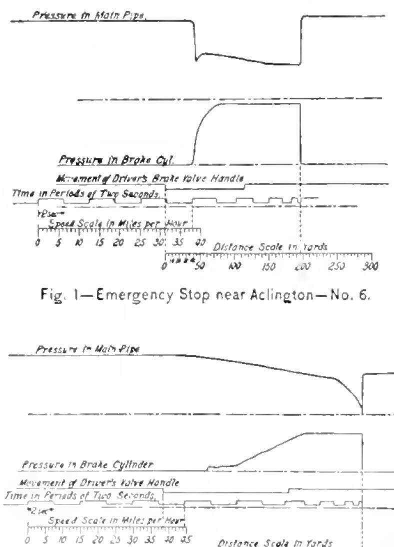


Fig. 1—Emergency Stop near Aclington—No. 6.

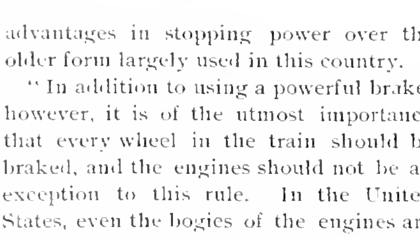


Fig. 2.—Emergency Stop on Approaching Alnmouth—No. 7.

advantages in stopping power over the older form largely used in this country.

"In addition to using a powerful brake, however, it is of the utmost importance that every wheel in the train should be braked, and the engines should not be an exception to this rule. In the United States, even the bogies of the engines are now equipped with brakes, with the most happy results. The days are now past that locomotive superintendents thought a locomotive too nice a bit of mechanism to ruffle its feelings by the application of blocks, rubbing it the wrong way. Sentimentality in this direction has happily died out, and things are being looked straight in the face now. English railways have been slow in keeping pace with the progress made in brake matters. They still use the ordinary Westinghouse brake, although the quick-acting system has for a number of years been a complete success.

"In other countries the preference is given to the quick-acting system, and, as is well known, a considerable portion of the freight trains in the United States are now equipped with that brake, and, as a consequence, the speed of freight trains has been increased in many cases up to the speed of fast passenger trains, with complete success and safety."

In reference to the trials, Mr. Worsdell says :

"If the average retardation or stopping power of the two brakes be taken over these experiments, the quick-acting brake gives 8.48 per cent., and the "ordinary" 7.01 per cent., which, at a speed of 60 miles an hour, would mean in stop distance 297 feet less run by a train fitted with the quick-acting brake. I do not consider any of the stops remarkable for efficiency. This, however, may be due to the train not having all wheels braked, all six-wheeled vehicles being in use, and in each of these two wheels were unbraked."

The following extract is from *Engineering :*

"The Northeastern Company has alone, among the large English companies using the Westinghouse brake, given the preference to the newer form ; but as trains increase in length and speeds are augmented, a change in this respect may be expected. We hear, by the way, that the Northern Railway of France has decided to abandon the use of the vacuum brake, with which the whole of their rolling stock has been equipped, and is replacing it by the Westinghouse quick-acting brake."

Shall an Award of Merit Be Given?

During the discussion of topical subjects at the Traveling Engineers' Convention, in Pittsburgh, last September, the question came up whether it would not be advisable to abolish the present system of rating men after they had been instructed and examined on air brakes, and substitute for it the establishment of a certain degree of proficiency which all would be required to reach before being considered competent. While there is considerable good contained in the proposed substitute, especially that part which would require the

low-rated man to become posted, as a whole it would be a crushing blow to intelligence, and would destroy all desire of the man to improve his talents by that noble competition inherent in all ambitious and self-respecting natures, and would place a discount on intelligence by drawing a line which would be the stopping place of all men, made equal by their arrival there.

One member made the remarkable statement that the highest-rated men on his division were doing the poorest braking, but in the discussion which followed, the fact was developed that while some high-rated men were unquestionably doing poor work, it was the exception rather than the rule; and as such men had a superior knowledge of the brake, their poor work was traceable to either carelessness or lack of judgment, and could be brought up to the standard by practical illustrations made by the traveling engineer in the same manner that he would correct improper manipulation of the engine.

The rating given a man is a mark or measurement of what his knowledge will do if he applies it with judgment. Judgment, however, must be inborn or acquired, for it cannot be supplied by the instructor along with the knowledge of the apparatus and its operation. It does not follow that a fireman who has passed a good examination on time-card rules and machinery is an assured success as an engineer, and will never be called up on the carpet to answer for some breach of judgment, traceable to something else than his knowledge of machinery and time-card rules. The fact that the office carpet, on some roads, is pretty well worn by frequent visits of violators of rules and good judgment is proof that others make mistakes besides the instructor—that is, providing one shall be held responsible for the acts of those whom he rates or promotes.

When the incentive to higher education in air brakes is withdrawn, interest will cease, and a mechanical, perfunctory spirit of "good enough" will supplant it, thus destroying not only the stimulus to higher education in air brakes, but also all kindred accomplishments which foster and encourage a desire for greater knowledge in all things.

It would seem but proper to urge the adoption of the good points contained in the proposed substitute for the present system of rating, and not saw out the top rounds of the ladder by compelling the ambitious man to hide his light under a bushel in order that a parity may be maintained between him and the fellow who has no talent, or one who prefers to keep his talents buried, a course which, if pursued, would surely serve to establish that bullyism which dogmatically asserts its equality with intelligence, and would encourage it in a refusal to stand forth alongside of the toiler in the broad, open light of day and have its true measurement taken.

A Valuable Air-Signal Testing Device.

The following extract, consisting of an air-signal testing device, and directions for using it in diagnosing an ailment, is made from the report of the Air-Brake Men's Proceedings, with the belief that the advice therein given is the quickest and most satisfactory means for solving and correcting the troubles experienced with the signaling apparatus:

In order that the defects in the signal apparatus may be located and analyzed to advantage, a testing device should be

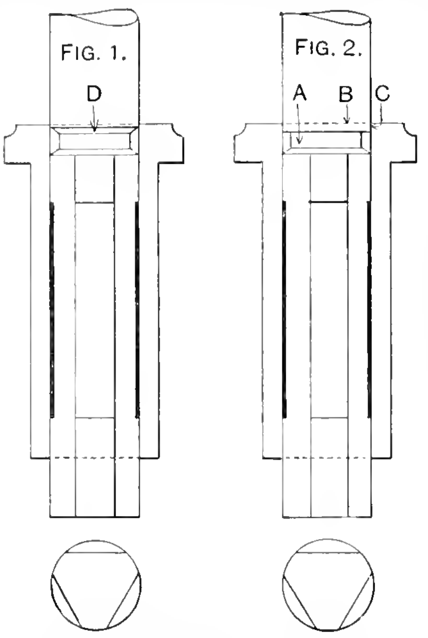


FIG. 1. Stem ruined by chamfered bearing.
FIG. 2. Stem as it should be.
A. Circumferential groove *B*. Top of bush. *C*. Bearing. *D* Bearing chamfered and reduced below limit.

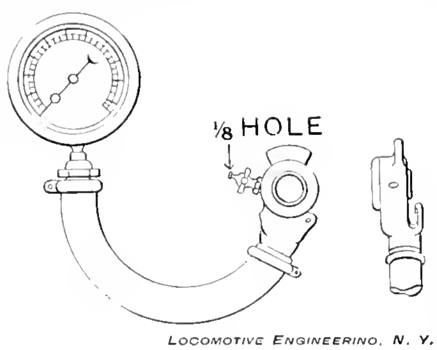


FIG. 3.

used; this device to be constructed as follows, and as illustrated in Fig. 3. An air-gage should be screwed into one end of a short section of hose, and the other end attached to a hose coupling, and into this coupling is screwed a small pet cock with a ⅛-inch hole through its plug; by this arrangement an exhaust of any amount or duration may be obtained by the manner of opening the pet cock, by quickly turning the plug, and as quickly closing it; it may be fully opened, and yet the reduction will scarcely be noticed on the gage, whereas it may be slightly opened and held opened, and the gage will show a reduction in proportion to the time it is held open.

By means of this device the following tests should be made to demonstrate the efficiency of the reducer: The signal line pressure of 40 pounds should be reduced to 30 by opening wide the pet cock in the signal device; it should then be closed, and the time it takes to restore the pressure to 40 pounds should be noted; if the rise of pressure is slow the reducer is feeding slowly, and it should be examined to ascertain the cause—this cause may be the gummed condition, and if this be true, it then becomes a question of cleaning; however, if it be an old valve, the lift may be insufficient to admit of the faster feed through it, thereby causing the trouble; this, of course, is easily remedied.

To ascertain the condition of the signal valve with the testing apparatus as described above, make a quick light reduction through the pet cock, and repeat this with an increased reduction until one pound has been reached; if then you fail to get a response from the whistle, the diaphragm is possibly defective, for one pound is sufficient to lift any diaphragm if in good condition; however, care must be taken to guard against the possible error of supposing that the failure just referred to is entirely due to defective diaphragm. It may possibly be the tight fit of the stem in the bushing. If the diaphragm is found to be defective, it will probably be buckled or distorted, and this in turn is due, in a great measure, to overheated air-pumps, too high pressure in signal pipe, and also to a sudden reduction of pressure from the signal pipe, which in turn makes a like reduction from the top of the diaphragm, while the underside not being able to discharge the pressure as quickly as the top, is thrust upward by this excessive pressure from below. The sensitiveness of the signal valve depends largely upon the condition of the diaphragm; if it be badly distorted or bagged, the diaphragm alone will move in response to a reduction from the signal pipe, possibly lifting the diaphragm to the highest position, and not lifting the stem off of its seat; this must, of course, be done before the air can pass to the whistle. With the testing device as described above, make a slow, gradual reduction from the signal pipe, trying to give it as nearly as possible the same effect as the sum total of all the leaks in a signal pipe; increase this leak until the whistle sounds, and if the valve fails to stand the test of the gradual reduction, the stem will be found to fit too snug. This too snug fit prevents the air from passing from the underside of the diaphragm to equalize with the reduction which is being made from the top. With the capacity of the reducing valve determined by the tests described, it will not be hard to determine what amount of air is necessary to be drawn from the signal pipe in order to overcome the amount supplied by the reducer; the leak through the testing device must be in excess of the amount sup-

plied by the reducer, else it will be impossible to affect the valve. This too tight fit of the stem may be due to its gummed condition; if properly cleaned the trouble in all probability will be removed; if not, then decrease the size of the stem with very fine emery cloth, but be careful not to make this reduction greater than necessary, for one extreme is quite as bad as another. If made to fit too loosely it will successfully stand the leakage test, but will refuse to answer to a light, quick reduction from the signal pipe. It will give a blast of the whistle from any car discharge valve of a short train, provided the valve is fully open and clean, but will not answer to the discharge from the rear cars of a long train. A bounding or repeating whistle is also caused by too loose fit of the stem in the bush, but may be remedied by lowering the stem in its bush; but the limit of $\frac{1}{16}$-inch between the circumferential groove and the top of the bush must not be exceeded as explained below. If the stem fits too tightly it will not stand the leakage test, as the whistle will sound shortly after a leak has been made from the signal pipe, and will not respond to a short quick reduction. When forced to act by a heavy reduction, the stem will remain raised some time, causing a long blast, and a heavy reduction will be noted on the test gage after the pet cock has been closed. When coupled to the train this valve will be found unreliable and erratic.

We scarcely realize the importance of the fit of the stem in the bush; it should be tight enough to allow the pressure from the underside of the diaphragm to raise it and form an equilibrium with the pressure in the signal pipe above when a sudden reduction is made, and yet be sufficiently loose to allow the pressure from the bottom to equalize with the top without lifting the diaphragm, as in case of a leak from the signal pipe. For this reason great care must be used to keep this stem in the proper relationship to the bushing, as either extreme will be disastrous to the successful operation of the valve. This fit of the stem may be compared to the quick-acting triple valve; it must be thrown into action by a sharp quick reduction, and refuse to act when the reduction is slow and gradual. The object in making these tests with the device described, is to submit the signal apparatus to the same conditions that it would be subjected to in road service. To test the apparatus by opening the stop cock at the rear of the train or tender is not a practical test, as the discharge is so far in excess of that through the car discharge valve; it is not only unreliable, but this manner of test is hurtful to the diaphragm. If there is a leak past the seat of the stem, it prolongs the blast of the whistle and renders the valve less sensitive. Care should be taken not to confound this with a tight fitting stem. As little grinding should be done as possible, as the stem is shortened, the length of bearing on the stem between the circumferential groove and top of the bush being lengthened beyond the limit, which will materially interfere with the performance of the valve. The fit of the stem in its bush between the circumferential groove and the top of the bush should never be less than $\frac{1}{32}$ inch nor more than $\frac{1}{16}$ inch. This fit of the stem should be close and true, for in the absolute fit of this lies the most important essential of the signal valve, and without which a successfully operating valve cannot be expected.

It sometimes happens that a whistle on an engine that is not coupled to a train will blow with no apparent cause, but when coupled to a train will act properly. This is due to a too tight fit of the stem, in combination with very small unnoticeable leaks; the leak of the short pipe of the engine and tender alone is more in pounds, due to difference in area, than that from the train pipe, hence act more directly on the valve.

A very sensitive signal valve will blow when engine is running fast over bad track and when seat-box lid is closed roughly; also when soft hammer or any other heavy thing is dropped sharply on the foot board, but may be remedied by dropping stem in its bush. Lead weights, spiral springs and other things placed on top of the diaphragm to correct over-sensitive and repeating valves, should be abandoned.

A weak blast or total failure of the whistle to blow may be from many causes, the following being the principal: Too low pressure in the signal pipe, due to defective reducer; dirt in the small port at the bottom of the signal valve; bell of the whistle too close to the bowl, and stem supporting bell out of line; strong wind blowing through cab window against whistle bell, which prevents the air from striking the edge of the bell squarely, and dirt in the air passage through the bowl of whistle. Raise the pressure, remove the dirt, and all will doubtless be well.

Recently Patented Valve for Air Brakes.

The device herewith illustrated and described embodies features covered by patents recently granted to Mr. S. H. Heginbottom, Saginaw, Mich. Following are the inventor's claims for his device, and a description of the patented features:

"The attachment or improvement hereinafter described radically effects the working of the driver brake and furnishes the following distinct advantages, viz.: It is an automatic detector of the stopping of the pump or any loss of pressure which will bleed the train reservoirs, but still not be sharp enough to move the triple valves and set the brakes. It permits the reservoir of the engine brakes to be filled almost instantly, and maintains under all circumstances the maximum effectiveness of this brake. It provides for an automatic action of the driver brakes simultaneous with the train brakes when the engineer's valve is thrown to emergency position. This makes the emergency stop doubly effective, because of the instantaneous response of the brake on which the engineer is not accustomed to rely. It saves wear and tear of the engine, because the driver brake will not be set on usual service stops. It causes the train to be brought to a stop with greater smoothness, and prevents the slack from running up to the engine.

"This apparatus consists of what is called a 'driver-brake-retaining valve,' which is situated between the train pipe and triple-valve piston and adapted to allow the free passage of air from the train pipe through the triple valve, but to resist the backward flow of the train pipe by means of springs until the pressure from the lower side of the triple-valve piston overcomes the springs. Operating in conjunction with this retaining valve is my improved driver-brake triple-valve piston, in which, in order to permit the driver-brake piston-valve reservoir to charge more quickly, I increase the number of ports around the piston and move the piston below the ports by a spring when the reservoir is filled.

"In the drawings, Fig. 1 is a sectional view of the apparatus and triple valve with improved piston and ports. Fig. 2 is a perspective of the retaining-valve piston.

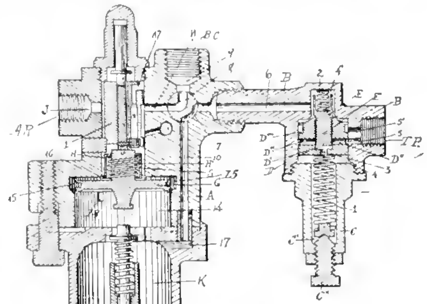


Fig. 1.

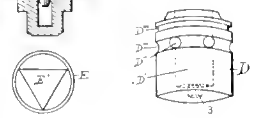


Fig. 3. Fig. 2.

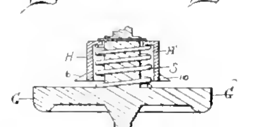


Fig. 4.

Fig. 3 is bottom view of the valve. Fig. 4 is a sectional view of my improved triple-valve piston.

"Piston D, spring 1, and non-return check-valve constitute the 'driving-brake-retaining valve' attachment. Spring 1, whose tension is regulated by set screw C, holds piston D seated upwards on a bevel seat. Valve E is seated downward in annular opening of piston D by tension of light spring 2. The pressure from train-pipe enters through ports 5 and 5^1 to annular orifice containing wings of valve E, filling space under piston D, then passing through valve E, which is easily raised to port 6; thence to the auxiliary reservoir as usual. Owing to light tension of spring 2, pressure will readily raise valve E, and pass to the auxiliary reservoir, but for pressure to return it must first overcome the tension of spring 1, which can be adjusted to any desired resistance, then the piston and valve descend to the lowest limit, and give a clear passageway. The rapid charging device consists of several additional ports 15, which are uncovered by piston G when at its uppermost limit, and allows pressure to pass into the auxiliary reservoir very quickly. When

pressures have become equalized on both sides of piston *G*, the spring *S*, which has been meanwhile compressed, will force piston downward into a position closing ports 15, and almost closing port 18, which gives the valve its usual sensitiveness to a decrease of pressure in port 6."

[This description is but a condensed extract from the lengthy and technical explanation sent us, but is nevertheless accurate, and, together with a little study of the illustration, will suffice to give readers an idea of the workings of the device.

The many rapid charging devices which have been patented from time to time have been found to be objectionable and impractical, for the reason that they deliver the greater charge to the head auxiliaries, owing to their being nearer the seat of supply, and will cause the head brakes to creep on after equalization between the head and rear ends of train has taken place. By adjusting the spring 1 to a high tension the inventor could prevent this, but in so doing would lose his stopped-pump detector feature, and thus find himself between the devil and the deep sea. He would also make it possible to accumulate an excessive charge in his auxiliary reservoir, which, when sent to the brake cylinder, would develop a brake power that would probably slide the drivers, and also cause the brake to "stick" so that it would require a higher main reservoir pressure than he had to release it. Here would be an aggravated case of "stuck brake" of the kind had when an engine with fully charged auxiliaries couples on to an uncharged train.

As the driver brake would always have the highest charged auxiliary reservoir, and would never be used except in heavy service and emergency applications, the tendency to slide drivers would be very great, inasmuch that the brake would seldom be used until after train had been slowed down to a low speed, at which the tendency to slide wheels is greater. The wear and tear of the cars in the train would be increased far above that had where a 75 per cent. driving brake of the continuous type assists in making each stop by holding its own share.

A service trial of this device would most likely develop the fact that it causes the graduating feature of the triple to become lost, for when a sufficient train-pipe reduction had been made to allow pressure in passage 6 to force piston *D* downward, the greater area then exposed by top of piston to this heavier pressure would accelerate downward travel of piston *D*, and permit pressure from under side of triple piston to be suddenly reduced and produce an emergency application of that brake.—Ed.]

Train crews should not think because the engineer has one or two air cars on the head end that it is a signal for them to make freight of themselves in the caboose when train is to be held down grades or stops at meeting-points are to be made. Help him by setting the hand brakes on cars right back of the air.

CORRESPONDENCE.

Beware of the Bunco Man.

Editors:

Will you kindly inform the readers of Locomotive Engineering that outside of the proceedings of the Association of Railroad Air-Brake Men I have had nothing whatever to do with any air-brake publication? This announcement is necessitated by the actions of certain unscrupulous persons who have found it to their interest to use my name in connection with a book now on sale.

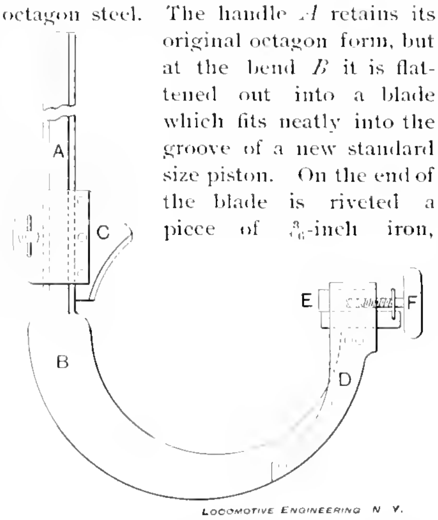
Robert Burgess,
Westinghouse Instruction Car.

A Handy and Useful Tool.

Editors:

Accompanying this description is a sketch of a tool which I have found very useful in cleaning out and truing up the grooves for new packing rings in old pistons of the Westinghouse 8-inch air pump.

The body of the tool is forged from octagon steel. The handle *A* retains its original octagon form, but at the bend *B* it is flattened out into a blade which fits neatly into the groove of a new standard size piston. On the end of the blade is riveted a piece of $\frac{3}{8}$-inch iron,



which is bent round over the end, and forms a socket *D* in which the cutter *E* is held, and adjusted by thumb screw *F*. By the use of different sliding shoes *C*, I am able to alter the tool so that it will fit either the $7\frac{1}{2}$ or 8-inch heads. The cutter itself is a piece of steel $\frac{1}{2}$ inch thick, and of such breadth as to finish the groove to the proper width, which will snugly receive the new packing rings.

I use this device as a hand tool by putting the work in a vise, and pulling the tool around after the manner of a spanner wrench, which it somewhat resembles. With it, I can fit in a set of new packing rings in fifteen minutes, and make a first-class job of it. Guy S. Hale.

Parsons, Kan.

Light Air Gages.

Editors:

I have a gage connected with a hose which I attach to the signal and train pipes at the rear of tender, and once a week I go over all my engines to test the reducing valve and the air gage in the cab. Frequently I find the gage in the cab will register but 70 pounds, while my test gage shows 80 pounds. The sudden variations of pressures to which an air gage is subjected make it very difficult to keep it accurate, and can only be done by constant attention and watchfulness.

Fred. Hain,
Gen. A. B. Ins., W. N. Y. & P. R. R.
Buffalo, N. Y.

The Automatic Driver-Brake Release.

Editors:

Seeing a cut of my automatic driver-brake release illustrated in your October number, as I requested, and comment on same, I wish to state for the benefit of your readers:

First: That water cannot enter the triple valve from auxiliary cylinder when piston is pressed upward, as there is a circular ground joint raised upon follower entering top cap. Should water get around the two packing rings in follower, and by said ground joint, it would flow away by way of pipe connection to waste cavity as shown. You will find that piston is also under packing nut and bushing inside of triple, and as the air pressure is downward it has a tendency to tighten the bushing against upward pressure, and as no pressure can exist above follower on account of waste port to atmosphere, no water can enter triple, and never has after a year's steady test. Second: Should pipe, by condensation, be full of water when engine throttle was shut off, the pipe would drain itself into chest by vacuum formed, and piston and follower would fall to seat by gravity and allow triple to act as before. Third: The chances of freezing up are out of the question, as a cock is placed in bottom of auxiliary cylinder in place of waste plug; and cock has a drain pipe, and no matter how cold the weather, by opening this cock enough no freezing takes place. Fourth: That gravity valve in brake pipe might not go to seat when air is put in pipe to brake cylinder is not at all possible, as the seat is ground and lift slight ($\frac{1}{8}$ inch), and seat is $\frac{1}{4}$ inch below bottom of brake pipe. You have same chance with receiving valves in Westinghouse pump, which don't often happen; and, Fifth: That every service of the triple has been complied with, as you will see per cut.

I claim the following necessities for the device:

First: At all times the driver brake is under control of engineer, and driver brake works with train brake except when steam is used or engine reversed, in which cases driver brakes should not be set; and, Second: Should tires get hot descending long grades on account of air-brake, it is easy to release without interfering with train brake. Should train part on a partial air train, you dispense with the shock that breaks draft gear by keeping engine throttle open. These facts have been

demonstrated by actual long tests, and proof can be got upon application to me. You state that driver brakes were used upon Northern roads for 18 miles on 116-ft. grade successfully, without injury. I wish to state that I am an engineer of years' standing upon many mountain grades, and I am a successful air handler, and my record can be easily obtained in the West, and I will say that I never saw this performance, as stated, with a driver brake properly adjusted.

If you will take the pains to examine driver brakes upon many roads, you will find in 60 per cent. of them that the shoe don't any more than touch the tire; 10 per cent. are medium; 30 per cent. good, and 70 per cent. hang upon engines as ornaments. Cause: Afraid that in an emergency case, if brake is in condition, that someone will slide the drivers or injure rods or driving-boxes, which is a wrong impression so far as rods and boxes are concerned. You state that a driver brake with 75 per cent. of weight on drivers is greater braking power than an engine reversed. It may have been proven, yet it looks plausible that an engine that can pull a train can stop it in a certain distance quicker than any driver brake can in the same distance. If, in accordance with existing rulings, the driver brake should work in conjunction with train brake, why is it not done upon heavy mountain grades similar to the Colorado Midland R.R. and other roads?

I hope you will give this statement due consideration from a practical standpoint.

Denison, Tex. W. PELHAM.

[The opportunity for leakage of water into the triple valve from the auxiliary cylinder would be almost wholly removed if circular raised ring on upper side of piston were located between the waste port and piston rod; yet, were this alteration made, the faulty construction which places a stuffing box (which is liable to leak when neglected) to separate moisture from air pressure, would still remain as a just remonstrance against the use of the device as a practical benefactor. Check valves are liable to catch dirt, and have never proved to be a mechanical success when used to retain a pressure for any length of time. The feature which prevents the driver brake from working in conjunction with the engine reversed is a good one.

The Le Chatelier, or water brake, assisted by a continuous driver brake having a cut-out cock in pipe between triple and brake cylinder, and operated from the cab, would be a far better scheme for cooling off heated driver tires, as the water brake would supply brake power in place of that lost by cutting out driver brake.

When partially equipped air-brake trains break in two anywhere behind the air cars, proper time-card rules for keeping head end clear until rear end is stopped, should be observed. But should the break in two occur anywhere between air-braked cars, steam should be shut off immediately, brake valve lapped, and gap between the two sections made as small as possible. When steam is used to keep the head end out of the way in the latter case, the gap will be widened momentarily; but, owing to the retarding power of the head section, which is all braked, the rear section, which alway has fewer brakes, will finally collide with the head section. The wider the gap made by using steam, the greater will be the crash when it comes.

Regardless of years of experience, you no doubt have, like the rest of us, something yet to learn, and we hope you may some day be able to witness this performance of continuous driver brakes on mountain grades and that it will give you as much pleasure as it did us. Reference to page 448 of July number of LOCOMOTIVE ENGINEERING will explain why a 75 per cent. driver brake will hold more than the engine reversed. The Doubting Thomas views of the relative holding power of the driver brake and engine reversed, as expressed by our correspondent, recalls the story of the old Darlington Englishman, who unexpectedly found his son confined in the stocks and subjected to the jeers of the crowd. "'Ow came thee 'ere, lad?" inquired the surprised and indignant parent. "Gittin' dthrunk, fayther," replied the son. "But they cawn't put thee in stocks for gittin' dthrunk, lad." "Cawn't they?" replied he. "Well, fayther, 'ere I is."

While we believe our correspondent's figures are much in error, the fact remains that the driver brake of some years ago did not give the splendid results, for reasons both just and unjust, that it is now giving, and will continue to improve upon as it is given an opportunity to demonstrate its just claim as a valuable adjunct to a continuous train brake in all classes of service. Some time ago, for our own information, we began to measure up the braking power on all engines coming under our notice which had the cam brake. An almost inconceivable discrepancy, due to carelessness in selection of cams and cam screws, regardless of weight of engine, radius of cams and length of cam screws, was found to exist. Some engines were braking as low as 25 per cent., others ran as high as 125 per cent., and looked innocent to the casual glance, but confessed their guilt to an analysis. The outside-equalized driver brake, being simple and easily calculated, is free from such intrigues with careless workmen, and, by permitting of a location for cylinder elsewhere than between the drivers against the firebox, has proven its superiority over the cam type on all classes of engines.

The possibilities of the continuous driver brake for heavy mountain service have not yet been determined; and the past record of steam, vacuum, straight air and independent driver brakes should not be taken as a measurement of what is possible to be done by a brake designed to meet the special requirements of different classes of service. For driving wheels, the percentage of brake power must be such that tire will not be unduly heated, and yet hold as much as possible. The forward truck brake is no longer an experiment, and is specially adapted to mountain and fast train service. A retaining valve on tender, and possibly on the truck brake, also, although a practically untried experiment at present, will undoubtedly prove a very great factor in determining to what extent the use of the continuous driver brake on very heavy mountain grades shall be carried.—ED.]

Watch the Air Gage.

Editors:

As I am a subscriber to LOCOMOTIVE ENGINEERING, I would like to ask you to help me out of a difficulty I am having with the air brakes on my train. I am in the suburban service in this city. My engine is equipped with the New York apparatus. We head into the depot and back out. Engine has been out of the back shop about six weeks. Upon trying to make my first service stop with train, I found that as soon as I stopped reducing and moved handle back on lap, that all brakes on train released, and every stop was the same way. With light engine the same performance was carried out. On arrival at the roundhouse I reported leaky piston valve in engineer's brake valve, and it was taken out and new one put in, but it worked just the same afterwards. The head machinist and several engineers declared that the valve was all right and that the trouble lay in the triples on the train. I invited them all, along with the Old Man, to come to the engine, and I would prove different to them. I pumped her up, lapped the brake valve, and asked them to step to the rear of the tender. I then opened wide the angle cock, which of course set the brakes, and told them to feel the hose and see whether any air came out, and they found plenty. Then I shut angle cock again, and in 55 seconds both driver and tank brake released. All hands except the Old Man still maintained that the trouble was in the triples, so a new brake valve was put on.

When the new valve was tested everything went lovely, and with the first train of five coaches the brakes were perfection, but when I backed out my last train of three coaches I found same trouble as before, but heading in with same three coaches the brakes worked splendid. This performance has been repeated for four days, and I have had different coaches each day. Backing out with four coaches brakes work O. K. I have examined all pipes very carefully, and main reservoir is all tight and well drained. The engineer's valve is perfectly tight. Can you give me any light on the case?

Chicago, Ill. J. G. HALLIDAY.

[There is little doubt that the trouble with the first case was leakage of main reservoir pressure into the train pipe; but

whether the fault was in the renewed leather packing, bolt in middle of piston, or bad joints in excess-pressure valve, remains for those who were on the ground to say. It is probable that your second valve has the same complaint, perhaps in a milder form, although you believe it to be tight.

Repeat the test with this second valve that you gave the first one, but, instead of holding your hand over the hose, immerse the coupling in a bucket of water, and look for bubbles. Notice if your train brakes do not remain set when pressure on your gage is reduced from 70 to 45 pounds, and released when pressure is reduced only 10 or 15 pounds.

Air brakes should remain set when train is backed up, the same as when going forward, unless rods, levers or trucks should foul in some way to affect the brakes; but we do not believe this has anything to do with your case. In heading into the depot, your thoughts are probably absorbed in stopping, and your train-pipe pressure is reduced below your auxiliary-reservoir pressure in making the stop. When you back out, you probably apply lightly, to wait for switches, and your pressure in train pipe and auxiliary reservoirs is equal when you lap your brake valve; then the main-reservoir pressure leaks through your brake valve somewhere into the pipe, and raises it above the auxiliary pressure, releasing the brakes.

The greater number of cars you have in your train, the less will be the tendency for the brakes to release.—Ed.]

Priority of Design Claimed.

Editors:

In October issue of Locomotive Engineering I noticed a cut of a signal whistle which was spoken very highly of. Too much, I believe, cannot be said in its favor. I would like to mention the fact that whistles of this type were used on the Scioto Valley Division of the Norfolk & Western R.R. two years ago by Mr. A. G. Sherman, air-brake inspector at Portsmouth, O. I had two of them with me, and exhibited them at the first annual convention of the Air-Brake Men's Association at Columbus, O., in April, 1894.

The whistle in question was made of a piece of ¼-inch iron pipe about 3½ inches long, one end of which was squeezed together for a half inch or so, for the double purpose of closing it and giving hold for a monkey wrench; the other end was tapped out to ¼ inch, and a ½-inch thread cut on the exterior. Beginning ½ inch from the end was a hole filed in the pipe ⅜ inch long and equal to ⅔ of the outside diameter of the pipe at its greatest depth. Screwed into the end of the pipe, so that its end was even with the square end of the notch, was a small brass plug, with one-third of its diameter filed off. A ¼-inch socket made the attachment to whistle signal pipe, making three pieces in all.

I am prompted to mention this, as I believe Mr. Sherman is also justly entitled to some credit in this matter.

Roanoke, Va. George Holmes.

Independent Driver Brakes.

Editors:

In a recent number of Locomotive Engineering Edward W. Pratt describes a very simple and apparently durable device for turning a continuous into an independent driving brake at the pleasure of the engineer. He asks that friends and enemies of the independent brake register their kicks and criticisms. As a friend of every modern improvement whose tendency is to lessen the dangers and simplify the equipment of engine-running of to-day, I will say that Mr. Pratt's device is the best little helper I have yet seen, and as in its use he still retains the automatic feature, I fail to see any objection to its use, especially on roads that are not very mountainous. On mountain roads, and they are by no means "isolated," *experience and facts, not opinions,* have taught me that an independent steam or vacuum brake on drivers is the best device yet gotten up for handling properly freight trains of any considerable length, and whose maximum speed is slow, as it always is, on heavy, continuous grades. Besides, if anything happens to air pump you still have a powerful brake to assist in holding train. It is to be regretted that men as intelligent and modern as the editors of Locomotive Engineering can only sanction the use of independent driver brakes in a few "isolated cases," as the best and most modern engineers I have ever met say that the independent brake has no equal for mountain service. I agree with the editors perfectly as to the use of the continuous brake, excepting on mountain power and switching engines. As far as gathering slack is concerned, any one can do it all right with the continuous brake, as there are no leakage grooves in the driver-brake cylinders, and by making a very small reduction you can get slack together the same, nearly, as with the independent brake, although you waste air, of course, in doing so, as the pistons under train will move out a little and leak off through grooves; but the main feature of the independent brake is to assist in steadying train while recharging; the retainers can't do it properly alone. Your speed will often become not maximum, but dangerous, before auxiliaries are properly charged for another application. I am positive that any man with modern ideas, who has ever handled trains on mountains, will agree with me that the independent driving brake is anything but an "ostracised parasite." The engine I have been running for the past three months is equipped with a continuous brake, and it is all right for ordinary stops—in fact, can't be beat; but as to being any account on mountains, with anything but a fast train, I must say that it is not in it with the independent brake. L. D. Shaffner.

Missoula, Mont.

[With due credit to Messrs. Pratt, Desoe and others, whose inventive genius has worked out novel ideas in independent driver brakes, the fact remains that no proof has yet been shown which would entitle that brake to be classed in the same category of necessary and useful appliances with the continuous form, either in ordinary mountain or level road service; nor why the adherents of the former type should claim progressiveness or profess sympathy with modern improvements.

Being quite well acquainted with the grades on the Rocky Mountain division of the Northern Pacific, from which place our correspondent writes, and having had personal experience in dropping trains down them, we are in a position to know the characteristics and requirements of service there. It was on a tea train, on one of these grades, that we saw a fine exhibition of the retaining valve's utility in mountain service. The train was an ideal one from an air-brake standpoint, and while being in better condition than the average train passing over that division, yet it served to demonstrate the value of the adequate assistance which the retaining valve rendered in holding train in check while auxiliaries were being recharged. Should very heavy grades make additional assistance necessary, it would be much nearer the line of progression to equip engine with Le Chatelier, or water brake, and provide a cut-out cock in pipe between triple and cylinder of driver brake, than to resort to the independent form, which has proven itself to be far from an unmixed blessing.—Ed.]

Effects of Thermal Changes on Air Pressure, and the "Sweeney" Compressor.

Editors:

The effect of heat upon compressed air, as indicated in the article by Mr. George B. Snow, in August number of Locomotive Engineering, recalls to my mind some experience I had with the "Sweeney" air compressor, while running an engine on one of the mountain divisions of the Southern Pacific road.

As has been previously explained, the "Sweeney" compressor is simply the engine reversed, and a connection between the steam chests and the main reservoir. Cylinder cocks being kept open when it is in use, allows some air to be drawn through them into the cylinders, but the majority enters from the smoke arch, and is consequently considerably heated before compression. Adding to this the heat generated by compressing it up to 70 or 80 pounds, it will readily be seen that the

temperature of the air on entering the main reservoir must be quite high.

In recharging a train with the "Sweeney," as it is commonly termed in the West, the brake-valve handle is placed in full release position, thereby permitting the pressure to pass freely back to the cars. The rapid flow gives so little time for the heat to radiate, that with a train of considerable length the brake valve frequently becomes too hot to bear a hand on. I noticed that, even where the train-pipe pressure was raised to, and maintained at, 80 pounds for a sufficient period to permit equalization between it and the auxiliary reservoirs, yet, on returning the valve handle to lap position, a reduction of about 5 or 8 pounds in the former would take place.

Equalization between the head and rear ends of train pipe may have had some effect upon this, but the loss was even more marked when the brake-valve handle had been placed on lap position while the "Sweeney" was in use, and about 100 pounds or more pumped up in the main reservoir. Here the known rate of leakage had to be allowed for, and with this considered, as before stated, the loss was even greater than that shown on the train pipe with the "Sweeney" compressing directly into it. F. B. FARMER.

St. Paul, Minn.

An Opportunity for Improvement.

The handy tool for truing up the grooves in piston heads, as illustrated and described in another column, will insure the performance of this part of the work, which is frequently overlooked, and will remove one cause of air pumps heating. A blue-ribbon award of merit awaits him who shall devise some handy method (not hand tool) for re-boring the air cylinder after it becomes worn large at the ends, and thus eliminate the most common cause of "pump runs hot and won't make air." New rings fitted into a cylinder of this kind are something like a round plug in a square hole.

Write on one side of the paper only. Have all communications in by the 20th, earlier if possible. When sending sketches or prints of devices for illustration, be careful to have same correct; and furnish, if possible, side and end elevations; also a plan view if that would aid in making the description better understood. Furnish a technical description of the device to be illustrated.

The 8-inch air pump is supplying pressure to freight trains, frequently thirty-five cars in length, on the Far Western roads which have heavy grades, but make no allowance for waste. This gives us a line on the man who can supply but five or six cars, and insists upon the remainder being cut out. He "hogs" the air that should belong to the other thirty cars.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(23) W. G. B., Paducah, Ky., asks:

What good reasons are there for a pump running hot on the air end? *A.*—Improper lubrication, such as low-grade, gummy oils; discharge pipe clogged up, improper packing of piston rod, badly worn rings in piston head, badly worn cylinder, which will give nearly as much trouble with newly fitted rings as old ones, insufficient lift of air valves, pump out of line, and valve cages poorly fitted, are the most important ones.

(24) T. L. M., Scranton, Pa., asks:

Can you recommend a good oil for the rotary valve? I clean my rotary about once a week, but sometimes I have to clean it twice or three times each week. What causes this difference that makes it run longer some times than others? *A.*—Tallow and beeswax, in proportion of two to one, and possibly a little graphite mixed with it, is a good lubricant. Hostlers, in spotting the engine at ash pit, water crane and coal dock, and putting engine over the table into roundhouse, will use the emergency oftener than a good engineer does in a week, and also cause more damage in so doing than legitimate service.

(25) J. C. K., Knoxville, Tenn., asks:

What is the meaning of the phrase, "Co-efficient of Friction," as used in Tables No. 1 and No. 2 on pages Nos. 109 and 110 of the Air-Brake Men's Proceedings? *A.*—The following clear definition of the term is quoted from the M. C. B. report of the Committee on Laboratory Tests of Brake Shoes, which says: "In order to make clear the term 'Co-efficient of Friction,' it may be stated that the co-efficient of friction is the relation of the total friction between two surfaces to the force pressing the surfaces together; in other words, it is the proportion which the pull on a brake-beam hanger bears to the force with which the brake shoe is pressed against the wheel. For instance, where the co-efficient of friction is shown as 20, it is meant that the pull on the brake hanger, or the retarding power of the brake shoe measured in pounds, is 20 per cent. of the force applied to the brake shoe through the brake beam."

(26) S. B. J., Syracuse, N. Y., writes:

Will you please explain what is the reason for one pair of wheels on a tender sliding and making flat wheels, and none of the others do it? *A.*—This particular case may be caused by a foreign lever having strayed in. Measure up the levers, and if such is the case, have the offending lever changed for one of proper proportions. A very common cause for one pair of wheels of tender trucks sliding is that the bottom rod from the live lever is fastened to the brake beam direct instead of the bottom end of a dead lever. This is a cheap way of putting up a tender brake, but it is bound to prove expensive in service by skidding the wheels which are braked by the live lever, as much heavier pressure is delivered to that beam. Wedge-shaped, sloping tanks have unequal weights on their two trucks, and would be liable to slide both pairs of wheels of the truck under the light end, if the leverage was the same on both trucks.

(27) C. W. D., Arkansas City, Kan., writes: I would like an explanation of this problem. A train stopped at a station; engine cut loose to pick up more cars, and I noticed the brakes release, then set, and continue so until engine came and took train away; it was a train of fifteen cars fully equipped with air brakes. *A.*—The small leaks in train-pipe probably caused the triple valves to move to service application position, and allow a corresponding small amount of auxiliary reservoir pressure to flow to brake cylinders, but not enough to force pistons past the leakage grooves. When an equalization between the auxiliary reservoirs and train-pipe took place the graduating valves in triples closed, shutting off the auxiliary supply; then the small amount in the brake cylinders escaped through the leakage grooves, and the pistons retured into the cylinders. When the engine retured and coupled up again she pumped into the train-pipe, supplying the leaks and kept the brakes off.

(28) C. W. H., Boston, Mass., writes:

An engine on the N. Y., N. H. & H. road, about to leave the house, showed 80 lbs. in train line and 70 in main reservoir; the red hand moved back and forth between the space of 5 lbs. at each throb of the pump, which was working moderately. The valve was of the D 5 pattern. Can you explain the cause? The gages were piped right, so was the governor, and nothing wrong could be found but a very small leak under gage. *A.*—As it is impossible to have more pressure in the train pipe than in the main reservoir when both pressures are connected together, one or both hands on your air gage must be out, and should be tested in the manner described in another column. The cause of the red hand fluctuating is probably due to the discharge pipe from the air pump being teed into the single pipe which connects the brake valve with the main reservoir. This is faulty piping. There should be one pipe leading from pump direct to main reservoir, and a separate one leading from the main reservoir to the brake valve. The small leak under the gage cuts no figure in this case.

(29) W. C. G., Baltimore, Md., writes:

In Mr. Wood's able article in April issue of LOCOMOTIVE ENGINEERING, pointing out the difference between spring and air graduation in triple valves, I would be pleased to ask what triple valve that was, or its catalogue number, where the piston is resting against the graduating stem and the port in the slide valve is not yet in communication with the one leading to cylinder, as with the present style of triple (air graduation), the piston in service stop position, the ports are in register. *A.*—The graduating ports of all plain automatic triple valves are open, partially, at least, when the piston will have moved against the graduating spring; and all sectional models of earlier and modern form prove this. It is true that the graduating spring must be compressed slightly to obtain a full port opening. Perhaps Mr. Wood may have met with a plain triple valve in which the leather gasket between the drain cup and triple-valve body was not of standard thickness. The thickness of this gasket has, of course, considerable influence on the opening of the port. Insufficient port opening was had with the first few quick-action triples manufactured, and a milling-off of the teat on piston was necessary to open up a free passage from auxiliary reservoir to brake cylinder.

(30) J. R. N., Indianapolis, Ind., writes:

A little while ago the wheels under a certain car were changed from 42-inch to 38-inch. There was considerable argument that the leverage under the car had ought to be changed also, for it was thought by some that the leverage that had been figured for a car having 42-inch wheels would slide 38-inch wheels. Please decide the question for the benefit of several of your readers. *A.*—The leverage

that is all right for 42-inch wheels is all right for 38-inch wheels and all other sizes in general use, providing, of course, the brake shoe and tire metals are not changed. There is a belief entertained by some car men that in changing from a large wheel to a small one, the relations between the shoe and tire and tire and rail are changed; but this belief is erroneous. The wheel, in this instance, may be compared to a bell crank lever, of which the shoe is the power end, the axle the fulcrum, and the rail the weight or result of forces applied. In changing from one size wheel to another, the arms of this imaginary lever would not be changed. If, instead of applying the brake shoes to a set of 42-inch wheels which carry a certain car, we were to fit two additional 42-inch wheels side by side on the same axle between the rails, and apply the brake shoes to them, it would be different. Now, with this example, if we were to change the 42-inch wheels which run on the rails for a set of 38-inch wheels, we would also be obliged to change the inside wheels to which the brake shoes are applied, else we would have a bell crank lever whose power end would measure 42 inches, and the weight end 38 inches, and we would have slid wheels.

In applying brakes, ordinarily, on a partly equipped air-brake train, be careful to reduce train-line pressure about five or six pounds on the first reduction; this brings brake shoes up against the wheels and causes slack of train to bunch gently. When crowding ahead sensation comes, then you know train is bunched, and brakes may be used as your judgment dictates. A ten-pound reduction on the start causes slack to bunch harshly, and is disastrous to lading and cars, and calls forth justly severe criticism from the crew in caboose, who, to save themselves from being tossed about at the pleasure of the engineer's whims, set up caboose or other rear brakes to hold slack out. Then the break-in-twos begin. Gather slack gently and use additional hand brakes right back of air cars, if any are needed.

It is pleasing to note that a larger number of the railroads throughout the country are making an effort to place their freight brakes in better condition. A very great number of brakes will necessarily have to be reclaimed from that state of almost entire worthlessness into which inaction, due to not switching them ahead and keeping them in constant use, has caused them to fall.

Conger's "Air-Brake Instruction Book" is the best for engineers, firemen and trainmen. Send 25 cents for a copy to LOCOMOTIVE ENGINEERING, 256 Broadway, N. Y.

After having made a gilt-edge air-brake stop, don't kick all the glory out of it by making a rough start. Rough starting is equally as objectionable as rough stopping.

A Link Grinder.

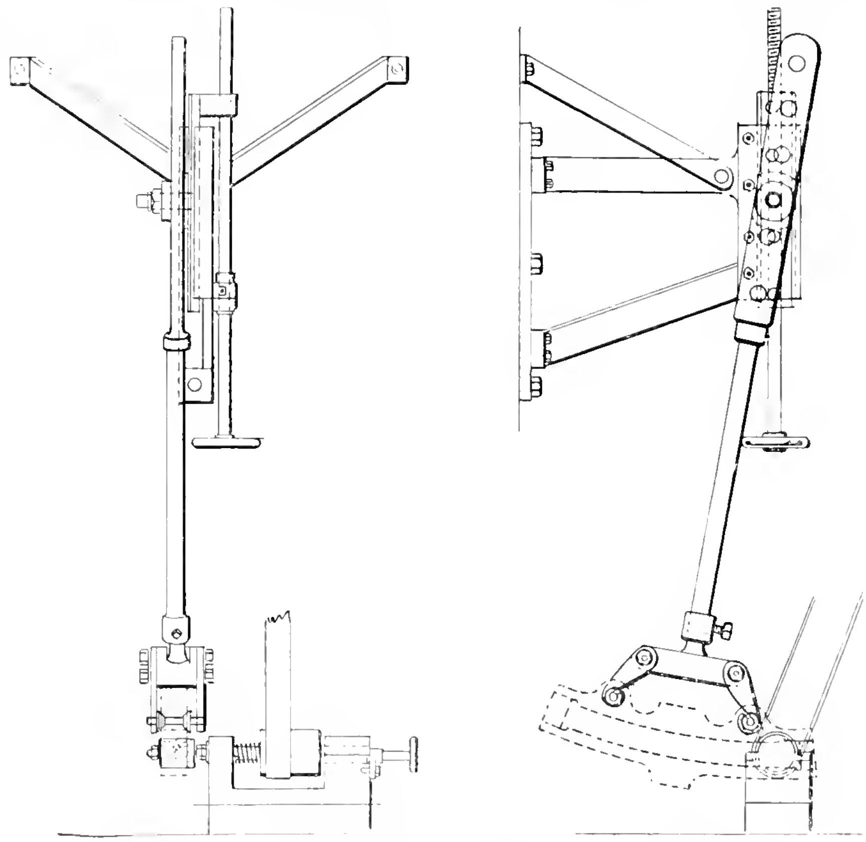
We illustrate herewith a very efficient link grinder, in use in several railroad shops in the country, in one form or another.

This particular one is at the D. & H. shops at Oneonta, N. Y., and is a very efficient arrangement.

By means of the hand wheel shown, the link-carrier can be raised and lowered during the grinding process.

The different holes in the top of the arm are for setting the radius for the different links to be ground.

The link is secured on cones bolted through the blade connections, as shown,



making the work done always measurable from the centers of the pins.

The link is moved back and forth over the emery wheel by hand, and the wheel itself is moved back and forth through the link, movement one way being accomplished by pushing in the knob shown on end of arbor, and the return being taken care of by the spring on arbor.

This kind of grinder occupies no floor space when out of use, is easily rigged up, casting little money, saving time and insuring more accurate work.

The handsomest tool catalogue in our collection comes from the Jones & Lamson Machine Co., of Springfield, Vt. This book is wholly devoted to a description of one good tool—the Hartness flat turret lathe—and its products. It gives cuts of different kinds of work done on a screw machine or turret lathe, shows how it is done and what time it takes to make the piece. This book should be in the hands of every master mechanic and shop foreman in the country. A comparison of the time used on studs, finished bolts, nuts, pins, etc., by this machine and his own tools would be an eye-opener. It will be sent, on application, to such men.

The Pneumatic Gate Co., of Chicago, report having closed a contract with the New York, Chicago & St. Louis R. R. for an equipment of thirty-six crossings in the city of Cleveland, O., with their purely pneumatic railroad gates. They will be installed in thirteen groups—each group to be operated from an elevated tower by the crossing watchman, who at some points will handle as many as four crossings and never less than two—combining great economy while providing more effective protection.

Engineers interested in hot pins and boxes—and any of them are interesting when hot, the pins, we mean—should send for a sample of Dixon's flake graphite, and a book they issue on "What the Boys Say About Graphite." Both sent free by the Jos. Dixon Crucible Co., of Jersey City, N. J.

The Foster Engineering Co., of Newark, N. J., recently equipped fifteen locomotives of the Lehigh Valley Railroad with their inside safety boiler checks, and have just received an additional order from the same road for thirty more of the checks.

Pneumatic Eye-Bolt Forming Machine.

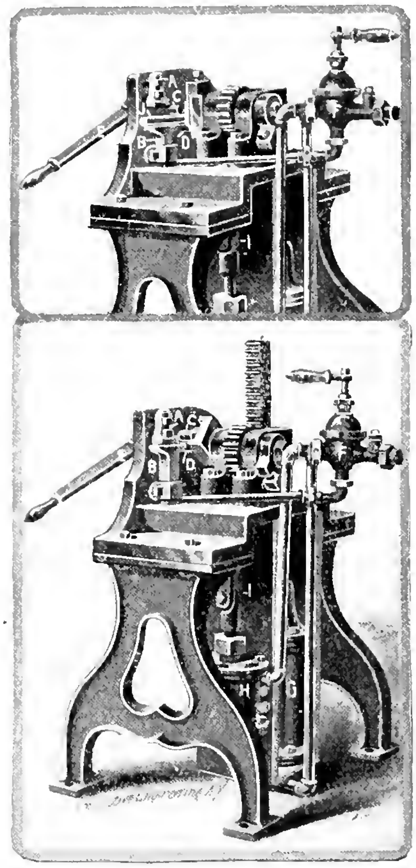
General Master Mechanic A. Vail, of the W. N. Y. & P. Ry., is an ingenious mechanic, and his shop is full of devices that prove his ability. On a recent visit to his Buffalo shop we were so struck with the "get-there-ness" of a home-made machine for forming eye-bolts that we at once laid plans for illustrating it—and here it is.

The upper cut shows the operating head with the ram down, the jaws open, and a rod, *J*, in place to be operated upon. The lower cut shows the ram up and the jaws closed, while the outline cut shows the details of construction of the head.

The lower jaw of the vise, marked *B*, is opened and closed by a 5-inch air cylinder, shown as *H*, under the machine. The ram or rack that turns the head is operated by an ordinary 8-inch brake cylinder, marked *G*. Air is handled on the machine by an old American steam brake valve *F*. A partial movement of the handle admits air to the small piston; this closes jaw *B* upon the work. A further movement of the handle admits air to the big cylinder, and the rack is forced up, revolving the shaft and head and forming the eye on the bolt.

The vertical plate forming the left-hand side of the machine, as shown in each cut, has the top jaw of the vise riveted to it and the lower one sliding in a yoke beneath. It also has an opening through which projects a pin, around which the eye of the bolt is bent. This pin is much larger where it goes through the plate than at either end; the outer end is fastened by a set-screw in a fork to the lever *E*, shown; this lever is used to pull the pin out of the eye just formed and allow the finished piece to be taken out of the machine. This pin is located on the center line of the jaws, so that when the red-hot rod is laid on the lower jaw and pushed back to the stop, the air forcing up the lower jaw bends the iron enough to offset it, so that the eye will be formed equally on each side of the bolt.

When the rod is clamped and air admitted to the large cylinder, the rack meshing into the gear causes the head



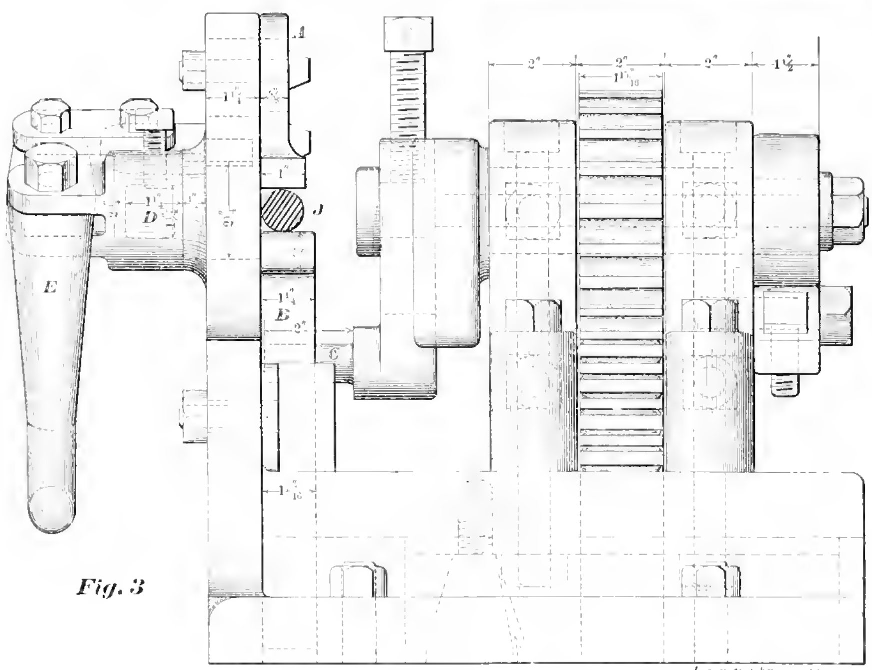


Fig. 3

with pin *C* to make part of a revolution, and this sweeps around the center pin, carrying the hot iron with it and forming the eye.

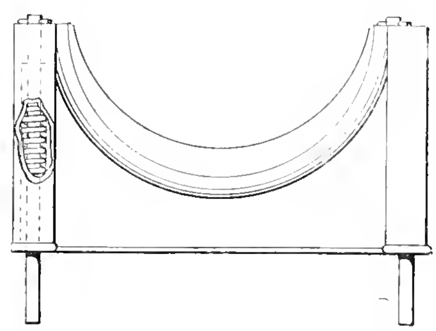
Any size of stock can be used, or any sized eye made, by adjusting the stroke of crank pin *C*, changing the size of center pin and adjusting the stop on the right-hand end of the shaft; this stop determines the stopping-point of the bending pin *C*.

This machine turns out first-class eye-bolts much faster than we can tell how it does it.

The machine is a credit to Mr. Vail and his chief draughtsman, who worked out the details, and it seems to us one that would pay for itself in a year in any railroad blacksmith shop.

A New Dust Guard.

Something entirely new in the line of a dust guard is shown herewith. It is made of cast iron, and is introduced into the box from the front, entirely ignoring the old time-honored slot provided as a receptacle for dust guards at the back of a box. This device is made up of a cast-iron frame, into which is cast a circular slot $\frac{3}{16}$-inch wide and deep to receive a strip of babbitt metal hav-



ing the proper curve to fit the dust guard bearing on the axle. The babbitt is held in contact with the axle by means of two coiled springs around the $\frac{1}{4}$-inch round spindles shown at the ends. When in position, this guard is entirely within the oil space of the box, standing against the end walls and held in place by the tension on the springs. It is the invention of Mr. Daniel Focer, a P. R.R. engineer at Cape May City, N. J., and has been in use under tenders on the Atlantic City runs for some time.

Handholds.

The Pennsylvania is in the handhold hustle with the rest of them, turning them out by the cord at the Meadows shops. The bulldozer does the coaxing into shape, but the dies leave a fin on the boss formed for the bolts, and to remove this flowed metal, Mr. Ferguson, the assistant master mechanic, devised a trimmer and punch, which is fitted to a larger power punch. This little combined punch and shear removes all useless projecting parts around the boss, and in the same operation punches the bolt holes, leaving a nice clean mechanical job.

The Pneumatic Hammer.

No small tool has attracted more attention from mechanics in late years than the pneumatic hammer.

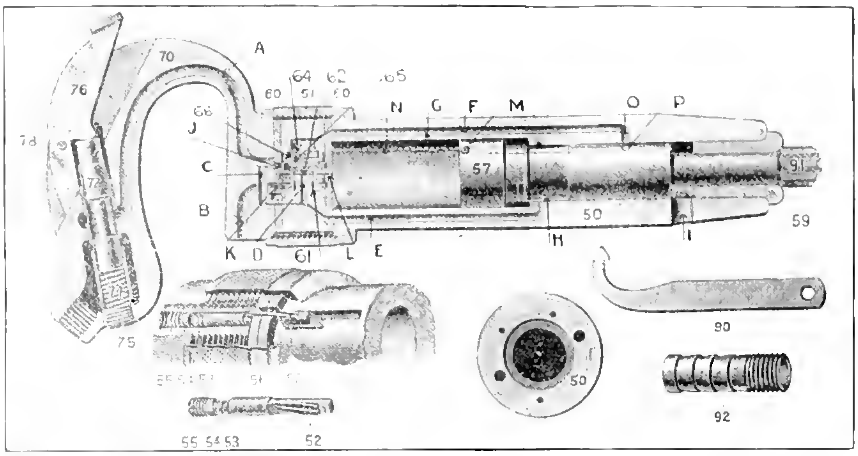
This little tool, held in the hand, strikes from 1,000 to 2,200 blows a minute, only weighs 8½ ounces, and does as much chipping or calking as three or four men with hand tools would.

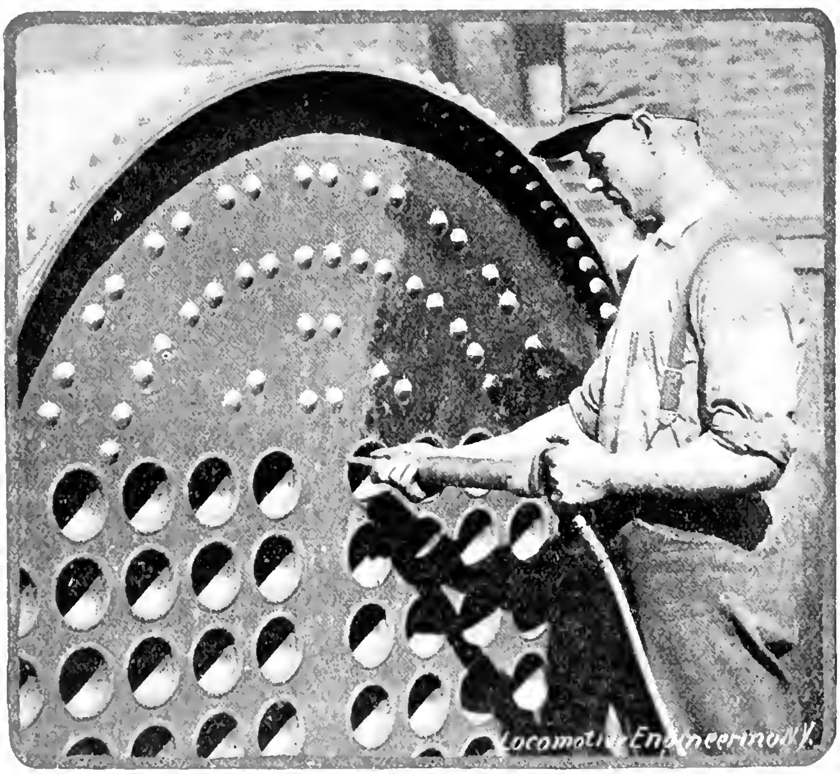
Our half-tone illustration shows the application of the tool to flue-calking.

The detailed engraving will serve to explain the *modus operandi* of the device.

As will be seen, the tool is held in the hand something the same as one would hold a pistol; one hand guides the tool and holds it in the hammer proper. It is not tight in the socket, and must be held in the entire depth to receive the blow of the hammer.

As will be seen, air is carried to the handle of the hammer through a small hose and is controlled by a balanced throttle valve operated by the thumb lever shown. Let us see the valve motion that can make a piston jump 2,200 strokes per minute:





The air, after passing the throttle, enters the passage *A*, whence it enters the inlet port *J* of the valve chamber, around the waist of the spool valve 61, through the cylinder port *L* into the cylinder behind the piston 57, the latter being forced forward by the pressure until the port *G* is uncovered, when the cylinder pressure is conducted into the valve chamber, forcing down the spool valve 61 (the position shown in cut), which opens communication between port *L* and port *K*, the latter opening into exhaust port *B*. From now on and until the piston 57 has completed its forward stroke, it moves under momentum only, until arrested at the moment of impact with the chisel shank 91, to which it delivers a sharp blow. The piston is returned to its starting position, partly by rebounding from the tool and by the constant pressure admitted through ducts *C* and *E* and port *H* against the annular area of the forward side of piston head. The pressure holding down the spool valve 61 in its exhaust position is retained by the check valve 64, the latter being held against its seat by spring 66. Valve 61 is so held until the extreme end of piston 57 uncovers port *P* of duct *N*, which communicates with and releases pressure under check valve 64, and allows the constant pressure against the diaphragm 62 in the waist of the spool valve 61 to raise the latter into position to admit pressure behind the piston for its next forward stroke. Port *P* when uncovered communicates with the atmosphere through large opening *I*, which also provides a "breathing" orifice for that part of the cylinder between bushing 59 and piston 57.

For calking flues, boiler and tank seams this little tool is a marvel, and is fast being introduced into railroad shops in this country. It is being placed on the market by the Chicago Pneumatic Tool Co., 1553 Monadnock Building, Chicago Ill.

Nursing the Job.

In a paper read by Mr. Clarence E. Bement, of the firm of Bement, Miles & Co. before an engineering society, the following remarks were made about the difficulties of the piece-work system:

In these days of piece-work there has arisen a new difficulty in manufacturing. It is called nursing a job, and consists in doing only as much for a day's work as will make fair wages and not lead to a cut, the man arguing that if he makes \$2.50 per diem on his machines his piece price will not be disturbed, while if he makes \$3.50 per diem, which he can easily do, it will simply result in his wages being cut to a basis of \$2.50, and making him work so much harder.

This system of nursing jobs exists in every shop where piece-work is being done, and especially where a number of machines are doing the same class of work, and you are largely dependent upon the sagacity of the foreman to discover and remedy the trouble. It sometimes necessitates the changing of the entire force. Another drawback to piece-work is the education of the men to think that it is worth more to do the same thing by the piece than by the day. For example, a man might turn out a hundred pieces of a certain kind for a day's work, for which he would be satisfied if he received \$1.50 per day, but if you wanted him to work by the piece he would expect to receive \$2 for the same amount of labor. In other words, the men look upon piece-work as a sort of fetich, which the employer is willing to pay something for worshipping.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

Sills and Truss Rods.

A comparison of underframing and truss rods in box-car construction has released the pawl controlling the gears in our think machine again, and while the wheels are going around in the comparator we will note some of the points. Among the very peculiar things, it is seen that the number and sizes of sills vary widely, giving the impression that this was a matter of so little importance that the builder need not confine himself to any stated number or dimension. One 60,000-pound car shows six sills $4\frac{3}{4} \times 9$ inches, and six $1\frac{1}{8}$-inch truss rods; another car of same capacity has six sills 5×9 inches and four $1\frac{3}{8}$-inch truss rods; still another one has eight sills of differing sizes, the two outsides being $4\frac{1}{2} \times 10$ inches, the four intermediates 4×10 inches and the center sills 6×10 inches, and four $1\frac{3}{8}$-inch truss rods. Now, we can go no farther without inquiring into the wherefore of this. Why is it that six $4\frac{3}{4} \times 9$-inch sills can be used in one case, and eight sills of greater weight are necessary in the other instance? In the latter case we find 44 per cent. more material than is required, if the former design is strong enough for service. Here is where the plot thickens, for the $4\frac{3}{4} \times 9$-inch sills have demonstrated their ability to resist shocks and stand all the grief that is their heritage, without a kick.

It is well known that sills will deflect by their own weight when not supported by the truss rods; with this fact before us, it is not easy to see the necessity for any increase in size, or a greater number, over those first cited. With the sills too weak to sustain any part of the load alone, reliance must be placed in truss rods of such a section as will support the total load on the sills between body bolsters; the failure to recognize this as a basic principle is one of the things that surpasses our understanding, almost making us ready to believe that there are no well-defined rules of practice to govern the construction of this part of a car, at least. This belief is further strengthened, too, by not only the diameter of truss rods, but also by the depth of their truss, for we have before us four $1\frac{1}{4}$-inch truss rods with $1\frac{3}{8}$-inch ends, having a trussing depth of 24 inches, and this to hold up a car with six sills; pitted against this is a car of the same length, width and capacity, having four $1\frac{3}{8}$-inch truss rods with $1\frac{3}{4}$-inch ends, and with a trussing depth of 32 inches, to hold up a load also carried on six sills.

There is an apparent inconsistency here, in that the $1\frac{1}{4}$-inch rods have the least depth of truss, when they should have the greatest, if the stress per square inch of section is to be kept below hailing distance of the elastic limit of the material in the rods. The depth of truss in these two cases should plainly be reversed, giving the 32-inch drop to the smaller diameter of rod, and thus reduce the unit fiber stress, which is equal to the total load on rods divided by the area of all the rods, and has a numerical value equal to $69{,}600 \div 4.9 = 14{,}200$ pounds per square inch on the $1\frac{1}{4}$-inch rods, a stress that may be safe for static loads, but hardly the thing to resist the pounding of the average right of way. The $1\frac{3}{8}$-inch rods, with their 32-inch drop, have a stress of $52{,}200 \div 5.94 = 8{,}700$ pounds per square inch, which is perfectly safe for all conditions. If, now, we change places with these rods, we will have for the smaller ones a stress per square inch of section equal to $52{,}200 \div 4.9 = 10{,}600$ pounds, and for the $1\frac{3}{8}$-inch rods a stress equal to $69{,}600 \div 5.94 = 11{,}700$ pounds, showing conclusively that the element of guess is too often the ruling factor, as in this instance. The $1\frac{3}{8}$-inch rods bear evidence of thought, and an acquaintance with correct principles that is painfully wanting in the arrangement of the smaller rods, whose haphazard and easy adaptation to duties requiring absolute safety, and bordering so closely on the danger line, shows such a meagre knowledge of even elementary mechanics that it appears almost criminal in the light of investigation.

The student will insist on getting below the surface in every instance where inconsistency shows its head, and will demand a lucid explanation of what appears to him a condition of cross purposes. What will the authors of these lessons in *experimental* mechanics have to say in defense of their position? Methinks they will have a hard time to make a satisfactory reply; the rule of thumb will not fill the aching void. The time is coming on apace when a show down will have to be made—and then what confusion and ridicule will be somebody's portion!

It is but a few years since it dawned on the minds of some car builders that there was any virtue in dropping the truss rods at the cross-tie timbers, or, in other words, getting a trussing effect out of the rods. Cars are still running with the truss rods held away from the cross-ties or needle beams by the interposition of a small casting which was manifestly placed there for the rod to chafe on, and not saw into the timber. These are light weights, to be sure, but they remain to mark the evolution of the truss rod. These old-timers were of low capacity, and short; and therefore a certain reliance was placed in the sills, which were always heavy enough to stand up under the load fairly well. The rods were practically tie rods only, whose office was to prevent pulling the car apart.

As the capacity and length of car increased, the necessity for truss rods became apparent, and then began the gradual drop at center of car, coming by tentative processes rather than by any effort to reach results by calculation, and thus know exactly what stresses the rods were taking care of.

Increasing the length of cars makes it impossible to expect the sills to hold up anything except their own weight, and they refuse to do this, as any one can easily demonstrate for himself by simply sighting along these members when unsupported by the truss rods. It may be said that the superstructure is framed with the purpose in view of making truss rods an unnecessary adjunct; it is true that this is done in some cases, but at a cost that has an unhealthy look when compared with the cheaper and lighter construction of our English friends, who do not build a box for the transportation of freight; a tarpaulin thrown over the goods wagon is good enough for them. If our traffic demands a cover, let us have it; but it should be light, and be a protection to the merchandise in the car, without any material addition to the dead weight. When this is done we must return to our first proposition, that the truss rods should carry the load; but to get results within the meaning of the word economy, these truss rods must be designed with a depth of truss suitable for the load they sustain and the diameter of the rods, or, in other words, a proper regard must be had for the ratio between the two sides of the triangle formed by the inclined portion of the rod

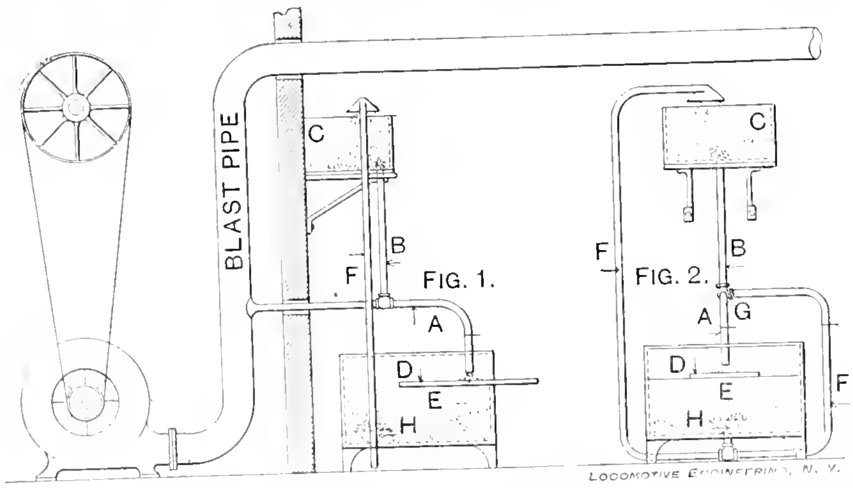
and a perpendicular let fall from the junction of the sill with the cross-tie timbers. As we have shown, it is this ratio that determines the unit fiber stress on the rods, and, therefore, the less the quotient obtained by dividing the inclined length of the rod by the perpendicular, the less will be the number of times the load will have to be multiplied to represent the pull on the rod. These comparisons of differing practice give evidence of a lack of appreciation of the importance of proper trussing.

Glass Ornamentation.

Among the appliances found in car shops for doing work cheaply and well, is now seen the device used in producing the beautiful frost effects on glass used for coach windows, deck lights and doors. It was thought an impossibility only a few years ago for an ordinary shop to do this work satisfactorily, and this belief was fostered by the trade concerns which made a specialty of this work, and did not propose to kill the goose that laid the golden egg; but the spell is broken, and there are now few roads that are not fully equipped to do it well.

Our illustration shows the scheme evolved by Mr. E. Mallinson, master mechanic of the Brooklyn Union Elevated Railway. Fig. 1 is the side view of the entire device and Fig. 2 the front view. The pipe *A* is joined to the blast pipe that furnishes air to the blacksmith shop forges; from a fan connecting with pipe *A* is pipe *B*, which is seen to pass up to a box *C*, containing the sand supply; the sand meeting the air in the pipe *A* is carried down to the frame *D*, containing the glass to be operated on and also the pattern which is to be reproduced on the glass. The pipe *A* is made to enter the top of box *E*, where the sand is caught after doing its work on the glass. The front of this box opens the full width and about 10 inches down, to admit the largest size frame, and at the bottom is seen a funnel at *H*, connecting with pipe *F*; this pipe, connecting with *A* at *G*, is also in communication with the air blast, and this is utilized to return the sand from box *E* to box *C*, the latter being secured to the wall at a convenient height to be out of the way. To elevate the sand, air is admitted to pipe *F*, and in passing the opening at the funnel *H* an induced current is set going from the interior of the box, on the ejector principle, this current taking a small quantity of sand along with it on its journey to the outlet at top of pipe *F*. All these pipes are fitted with valves of the gate type to properly control both sand and air.

The beautiful tracery seen among the designs here betokens no slight acquaintance with artistic work of a high order; the stamp of genius was driven in good and deep on some of them. The satin-like finish produced on the glass by the sand blast excelled anything we had seen in this line heretofore; it can be attributed to the very soft blast furnished by the small fan. This being contrary to usual practice is worthy of note, as a great many shops make connection with the yard air supply and wire-draw down to the supposed pressure required, with the result that while the glass is frosted it is coarse and lacks the pearly effect produced by the lower air pressure.



Freight Car Sizes.

In our August number we had something to say about freight-car design, in which we bore down hard on the lack of uniformity in size of cars of the same nominal capacity. On September 19th representatives of the M. C. B. Association, together with a committee from the Central Traffic Association and the Western Freight Association, met at Chicago for the purpose of discussing this question of freight-car design, with the object in view of reaching a limit in the size of freight cars, and to establish standard dimensions for same.

As a result of this meeting, their joint committee has sent a circular to all railroads, asking for information as to dimensions, weight and capacity of their equipment, with a view to making recommendations at a future meeting. We are pleased to know that a decisive move has been made in this matter by a representative body, for the reason that it is the key to which our lyre has been attuned for a long time now. The effect of the move is easy to foresee: the monstrosities and jumbos are likely to get an airing that will show them up in all their hideous deformity, and a reform will be commenced which is certain to result in a lighter car, which means more pounds of paying load per pound of dead weight hauled than has been the practice of late years. It will have a tendency to stop juggling with car proportions, if it is productive of no other good.

The Leland & Faulconer Mfg. Co., of Detroit, are meeting with great success in the demand for their wet emery-wheel tool grinder. Special care has been taken in designing this machine to avoid annoying contrivances which have made other machines of this kind unpopular. It has no pump, hose, piping, wet pump belts, filters, chains or treadles.

The old and well-known house, the Huyett & Smith Mfg. Co., of Detroit, have changed their name to the American Blower Co., which describes in a measure their business, which consists principally in the manufacture of hot-blast apparatus, dry kilns, fans, blowers and engines.

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Is looking forward to the day when he will become a full-fledged locomotive engineer.
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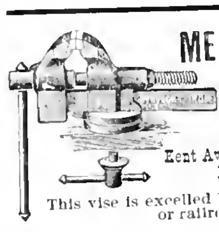

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No. 8 Sturtevant Blower.

New—perfect condition (noiseless), all attachments, including countershafting.

Foster Air Pump.

No. 2 Steam Air Pump for air pressure —new and in perfect order.

No. B4½ Pump.

For cold water; new and in perfect order.

Oil Tanks.

Two—6ft. x 24ft., Bumptead heads, manhole, caulked inside and out, guaranteed under pressure 30 lbs. to sq. inch; new, never used.

Feed Water Heater.

200 H.P.—new, perfect condition.

Engine.

200 H.P.—new, Duplex engine, or two horizontal engines connected by one shaft—automatic cut-off and independent cut-off valves; condition first-class; specifications shown.

Boilers.

Two 100 H.P. horizontal tubular boilers, each 76 inches diameter, with 98 3½-inch tubes 16 feet long; new and thoroughly first-class material and workmanship used according to specifications.

The above, together with shafting, pulleys, belting, scales and miscellaneous tools, and main building (208 x 52 feet), modern and perfectly equipped, resting on an unexcelled factory site (567 x 367 feet), Hudson river and R.R. tracks at the doors, is offered—all or part—by the Receiver, at figures which make it an object to any buyer in this line.

The entire plant—as it stands—the site, buildings, machinery and equipment, is *ideal and up-to-date*, costing upwards of $60,000.00. It can be quickly converted into almost any sort of manufactory, malleable iron, or car-coupler works, etc., and the price—owing to peculiar conditions—makes it an object worthy of some correspondence, which is freely invited; or a visit to the premises—(still better).

If you ain't interested, perhaps some of your friends might be, and would thank you for the information, so cut this out, and bear the Receiver's address in mind:

HENRY L. SMITH, *Receiver*,
50 State St., ALBANY, N. Y.

Increasing the Size of Freight Cars.

The New York Railroad Club, always at the fore in the discussion of live questions, have gone on record on the subject covered by the above caption, by appointing a committee to investigate the situation with reference to large freight equipment. This is in line with the alarm we rang a few months ago, when, referring to a reason for the load capacity of a car, we said, "Let it come from those who are fitted by experience to pass on this important question." The outcome of this move will be the airing of some men's views that will deserve to be regarded as classics by the rank and file, and will be the means of getting at bottom facts by men who know how to reach a result on logical lines. If there is any good reason why the size of freight cars should be increased, that reason should become common property at once. If these large cars are built and run at a loss, the railroads may be interested in that fact, to the extent of turning down further orders for same. The question should and will be probed to the bottom; it's a meaty one, and has talent on both sides that will not hesitate to dip their claymores in gore. Let the red flow; no great reform was ever accomplished without the loss of more or less of it.

Magnesia Boiler Covering.

The Keasbey & Mattison Co., of Ambler, Pa., makers of the famous magnesia boiler covering, are so pushed with orders from railroad companies that they have been compelled to enlarge their department devoted to this work. They are very careful about filling orders for this material, and will not sell it unless they are satisfied it will be properly applied. They insist on having blueprints of the boilers, to provide all dimensions. Their workmen then fit the boiler covering, as a tailor fits a man for a suit of clothes. When the material is applied in this way, it is as durable as anything ever employed for this purpose. When it is applied loosely, the vibration works openings between the blocks.

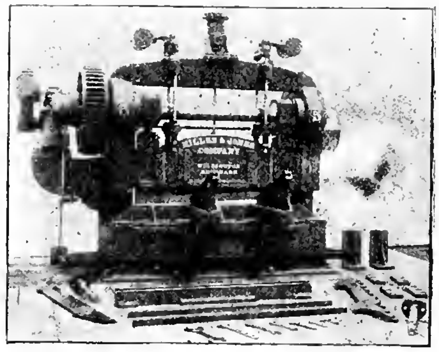
This company has lately sent considerable boiler covering for locomotives to Russia, Japan and Australia.

The magnesia used for boiler covering is extracted by the Keasbey & Mattison Co. from the magnesian limestones which abound in the neighborhood of Ambler, Pa. This company was the largest manufacturers of magnesia in the world before they commenced using it for boiler covering. The application of it to this line of art was accidental. Someone discovered that magnesia was an excellent non-conductor of heat, and suggested that it could be used in the manufacture of boiler covering. Its non-conducting qualities are due to the innumerable small interstices which are found between the crystals. These hold air, which is a poor conductor of heat and circulates very languidly in the mass. As made up for boiler covering, magnesia is used along with asbestos to form porous blocks, which are remarkably efficient for the purpose employed.

Bevel Shearing and Multiple Punching Machine.

The machine shown herewith has just been brought out by the Hilles & Jones Co., of Wilmington, Del., and has several unique features.

It is intended to punch material about ¼ in. in thickness. The arrangement of the punch and die holders is very convenient, and a defective punch or die can be replaced in a few minutes. In addition to the punching tools, this type of machine is often supplied with a pair of knives for either vertical or bevel shearing. The illustration shows the arrangement for bevel shearing in place. An automatic clamping arrangement clamps the plate in advance of the punches striking it, and



holds it in place until after the punches have been withdrawn. The sliding head is counterbalanced by steam or air pressure, cylinder shown at top. There is an improved automatic stop, which will bring the sliding head to rest at any desired point. These machines are adapted for either pulley, engine or motor driving, and of any desired width between housings and capacity.

For such work as tanks, this machine would be particularly efficient, punching, as it does, a row of holes, uniformly spaced, the full width of the machine, and shearing light plate square or on a bevel.

The Pocket List of Railway Officials has been greatly improved by putting headings over the departments of all large roads, and grouping all officers in each department under the same.

The Valley Railway, with headquarters in Cleveland, O., which has been for several years in the hands of a receiver, has been finally absorbed by the Baltimore & Ohio.

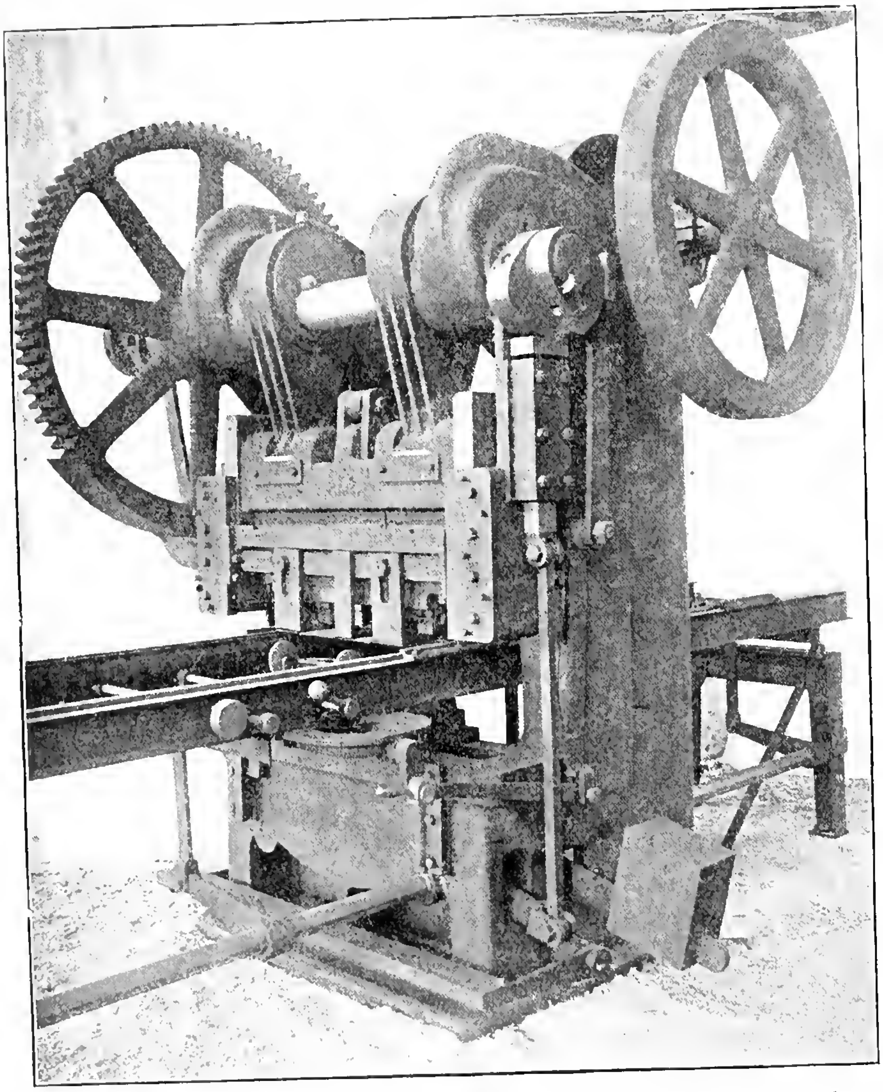
The Utica Steam Gage Co., of Utica, N. Y., issue a small circular called "Historical Pressure Gages," which gives an interesting history of the development of the pressure gage.

Powerful Punching and Forming Press.

The machine illustrated here was made direct from a photograph of a new tool recently turned out by Williams, White & Co., of Moline, Ill., for punching and bending work at one operation.

The one in the illustration was made for the Sheffield Velocipede & Car Co., of Three Rivers, Mich., for punching and bending up at one operation the teeth of their new plate-steel cattle guard, illustrated in our August issue.

The carriage is arranged to handle heavy pieces with ease; the plate holder and strippers are in plain sight, and the automatic feed is positive.



This machine is designed to do much of the small work usually done on bulldozers, where the pieces can be cut from sheets or straight pieces. A special adaptation of the machine being usually made for special parts.

A Flower Locomotive.

A model of one of the popular passenger locomotives of the Delaware & Hudson Railroad, made up from flowers, attracted great attention at a recent exhibition at Saratoga, N. Y. The engine stood on wooden tracks built on a bed of gravel and stones. It was 30 feet long and the smoke stack stood 10 feet and 6 inches from the ground. The brakes, the wheels and the mud guards were made of moss and golden rod. On the hubs of the drivers were sunflowers. The connecting rods were made of hydrangeas, as was also the reversing lever, which was visible inside the cab. The cab was made chiefly of golden rod and moss with trimmings of white asters. The boiler was of blue asters with bands of yellow marigolds. The tender was made of oak and maple leaves with the tint of autumn, and was trimmed with golden rod, asters, marigolds and other flowers. The number of the engine, 210, and company's monogram, "The D. & H.," were worked in the proper places with yellow immortelles. The steam dome, the smokestack, the headlight and the side lights were made of blue immortelles. The bell was made of yellow immortelles and the bell cord of white immortelles. The pilot was made of moss, golden rod and immortelles. It was drawn by eight horses led by grooms and attended by four train men in uniform.

We have received the Nineteenth Annual Report of the Department of Public Works of the City of Chicago for 1894.

IF YOU DON'T KNOW ABOUT P. & B. RUBEROID ROOFING YOU CAN'T BEGIN TOO QUICKLY TO FIND OUT.

WE HAVE BOOKS ON THE SUBJECT AND SAMPLES AWAITING YOUR ADDRESS. BETTER WRITE FOR THEM AT ONCE.

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Discipline Without Punishment.

The Brown System, with Improvements, as Adopted by the Fort Scott Road.

Every month we find railroad managers investigating and adopting the plan of discipline proposed in this paper in February, 1894, by Mr. Geo. R. Brown, general superintendent of the Fall Brook Railroad, and practiced by him.

The old, brutal, meat-axe way of disciplining men by lay-offs has done as much to prevent efficient service as to encourage it. Knowing that they would be robbed or starved for every mistake causes men to invent fairy stories to explain road trouble, instead of telling the truth and letting the officials apply the needed remedy.

We are inclined to think that the credit system inaugurated on the "Ft. Scott" will be a good thing, and that the best men will keep even for many years to come.

When a man makes a mistake once he is less liable to make the same mistake again than a new man is.

Discipline without punishment is the greatest step in the right direction that operating railroad officers have adopted in many years—it cannot grow too fast.

We contend that its author should have the credit due him, and the best credit that can be given is to give the system his name. As the "Brown System of Discipline" this new reform should be known, and we hope it will be.

The following bulletin makes plain the variations as adopted on the road mentioned. The changes consist principally in the sixty bad mark limit and the credit system:

Kansas City, Fort Scott & Memphis Railroad Co., Kansas City, Clinton & Springfield Railroad Co., Current River Railroad Co.

Supt's No. 122. S. M. P. & M.'s No. 529.

Notice to Enginemen, Trainmen and Switchmen, Kansas City, Mo., September 26, 1895.

Beginning October 1, 1895, a system of marks will be used instead of the present system of suspending for carelessness or neglect of duty except, that

Employés will, as heretofore, be discharged for drunkenness on or off duty; for drinking intoxicating liquors on duty; for frequenting saloons or other places of low resort; for incompetency; for dishonesty, and for other serious offenses.

And suspension will be imposed when the head of the department deems discipline by marks unsuitable to the case or the individual.

Where a suspension of ten days was formerly given, ten marks will be assessed, save for the repetition of the same offense, additional marks may be given.

Each person will be entitled to sixty marks before dismissal.

For every twelve consecutive months' service free from demerit marks, twenty marks will be deducted from any that may have been entered against a person's record.

No deductions will be made for less than twelve consecutive months' perfect service.

Each offender will be given notice of all marks assessed, and when the head of the department deems it advisable the offense and punishment assessed will be bulletined, omitting names of offenders.

All parties affected by this notice start with a clear record on the above date, save that where the future records of parties concerned shall show that past offenses are being repeated, and that former consideration for the offender has not brought about the desired result, the person concerned may be summarily dealt with or given double marks as the case may merit.

On account of the liberal allowance of marks given under this new system we shall expect a more prompt response to the various rules and bulletin orders.

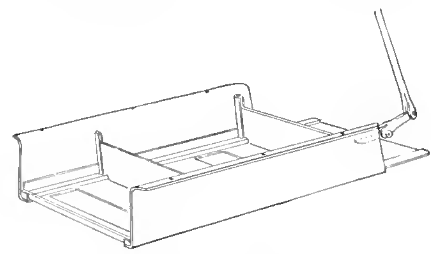
It is not the intention by this change to relax discipline, but to enforce more fully the observance of existing rules.

The system of reward for satisfactory service will give opportunity for rectifying past errors, which we think will be appreciated.

W. A. Nettleton,
J. H. Emmert, Supt. M. P. and M.
Supt.

A Self-Cleaning Ash Pan.

Our engraving shows a locomotive ash pan with several new features. It is constructed with a sliding plate in the bottom, covering two or more openings. One of these openings is directly under the dump-grate and the other at the back end of the pan. A standing scraper is fastened crosswise of the pan at the back edge of these openings, so that when the slide are drawn back the contents of the pan is dumped through these openings in the bottom. This sliding plate is held in position by



guides running full length of the pan, making the pan proof against dropping fire. The pan can be cleaned with both dampers closed.

It does away with one man at the cinder pit, as it is operated from the cab by a suitable lever, and can be operated by hand, steam or air.

The pan is not expensive, not costing more than the common ash pan. It does not have to be dropped to replace or work on the grates, as the openings in the bottom give the boilermaker ample room to work. It is also a protection to life and limb, as the fireman does not have to crawl under the engine to clean the pan.

It is being put on the market by Edward Wall and J. R. Scott, of Chanute, Kan.

We are in receipt of a new catalogue of valves and packing from the well-known house of Jenkins Bros., of this city.

John Wiley & Sons, of this city, have issued a revised edition of Hall's work on Car Lubrication.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(143) C. E. S., West Norfolk, Va., wants to know how to protect a water-pipe line exposed to the air and prevent freezing. *A.*—This will be a difficult thing to do; magnesia covering or mineral wool packing in a heavy box would do for ordinary winter weather, but the best remedy in low temperatures has been found to bury the pipe below frost line. If this cannot be done, a line of small steam pipe laid in the box will effectually prevent freezing.

(144) P. C., Buffalo, N. Y., asks what determines the amount of lead given an engine? *A.*—Lead is governed by the weight of reciprocating parts, and the service in which an engine is used. Its function is to have steam on the face of piston before the beginning of stroke in order to insure smooth running. Since the factors given above are variable, it follows that the lead opening is best found by experiment for the speed the engine will run at when in actual service. An engine running at high speeds will, therefore, require a greater lead opening than one used in slower service. All that is required, in any event, is merely enough to result in the least shock to the reciprocating parts.

(145) J. A. B., Spangler, Pa., wants to know why the counterbalance on the front drivers is as heavy as that on the main drivers. *A.*—It is sometimes necessary to counterbalance an engine in this way, for the reason that there may not be enough room in the main wheels to get in their correct share of counterweight. In cases of that kind, the proper amount of weight that should go in the main wheels is equally distributed between front and back drivers, in which event the wheels named would have more than their proportion of counterbalance and the main wheels less, but the whole engine would be supposed to be in balance, assuming, of course, that the correct balance had been calculated.

(146) H. O. B., Blue Island, Ill., asks: What is the correct definition of the word locomotive?—*A.* The word locomotive is from the Latin, *locus* a place, and *motio* to move, meaning to move from place to place, changing place, or able to change place. 2, What is steam? 3. Can steam be seen?—*A.* See answer to these questions in this column. 4. What is smoke? —*A.* Smoke is the visible exhalation, vapor, or substance that escapes, or is expelled from a burning body, especially from burning vegetable matter, as wood, coal, peat, etc. In the case of an engine, smoke is the product of the gases of hydrocarbons raised to a high heat without having sufficient air to cause combustion, disengaging the carbon in a fine powder, which forms smoke; this carbon deposited on solid bodies is soot.

(147) W. O. W., Cleveland, O., asks:

1. What is steam? *A.*—Steam is the result of subjecting water to the action of heat, and is water in the gaseous condition.
2. Can steam be seen? *A.*—No; that which we see and call steam is made up of finely divided particles of water, and is the condensation of steam by contact with the air.
3. What is the advantage an English inside-connected locomotive has over the American outside-connected locomotive, or have they any? *A.*—It is claimed by the friends of the English engine that they ride smoother on account of the cylinders being between the frames, and thus have less leverage to cause a rolling motion, as the cranks are nearer the center line of engine, and this location of the cylinders and valves is the very best possible to prevent condensation in the cylinders, for the reason that they are protected by the smokebox and receive the benefit of the hot gases therein. On the other hand, these parts on the American engine, although more exposed, are more accessible in case of needed repairs. The English engine having a plate or slab frame, can have a wider firebox between the frames than the American engine, but the latter gets an increased heating surface by placing the firebox above the frames. There are certain fixed conditions limiting the design of both engines, and each is undoubtedly best in its own particular field.

(148) A. L. H., Fairmont, Va., asks:

Can you tell me how long water can be off of the crown sheet when engine is hot, before the soft plug will drop. I have had several controversies in regard to this question. *A.*—The length of time elapsing before the soft filling of a fusible plug will melt, after the crown sheet is uncovered, depends, first, on the character of the filling, which must be such that it cannot be impaired by long exposure to heat, and second, on the temperature to which it is exposed. The alloy used should be such as will melt at a temperature slightly greater than that due to the maximum steam pressure carried on the boiler. As an example, we will take a boiler pressure of 150 pounds by gage; this will be equal to 165 pounds absolute, and the temperature due to this pressure is 366° Fahr. The filling for this temperature should be composed of eight parts of tin and eleven parts of lead; this alloy will melt at 400° Fahr., which is equivalent to a boiler pressure of 225 pounds. From this it is seen that the composition used in a fusible plug is an important factor in the time for it to melt or fuse, and without this is known, any answer to your question is purely speculative; however, it is safe to assume that a plug made of good material, and with the proper alloy for the pressure carried, will melt on the instant that it is uncovered. These conditions are ideal, of course, and assuming that the plug is in contact with the water. In railroad practice this is rarely the case, the plug being generally coated with scale.

The Ajax Metal Co., of Philadelphia, are feeling pretty good over the fact that the New York Central engines that broke the record for speed have Ajax bearings. Keeping cool under such circumstances is a virtue indeed.

The Trojan Car Coupler Co. have furnished the couplers for 200 gondola cars, building at the Barney & Smith Mfg. Co.'s shops, for the Washington Coal & Coke Co.

Bryan & McKibbin, of this city, have been made Eastern agents for the Oriel Lumber Co., of St. Louis, and for the Buckeye and the Little Giant couplers.

The Brady Metal Co. and the Page Wheel Co. have moved their offices into elegant new quarters, 100 Broadway, fourteenth floor.

Anyone interested in painting or varnishing cars or locomotives should send to the Detroit White Lead Works, Detroit, Mich., for their little books on these subjects. Their color plates would be of service to any painter.

Extracts from Letter from an Engineer Who Has Ceased to Worry Over Several Things that Have Caused Him Great Annoyance Heretofore, and Who Wants His Fellow Engineers to Know the Secret of It:

Perhaps I can say a few words about Dixon's Pure Flake Graphite which will interest some of my brother engineers who are worrying, when out on the road, about that hot crank-pin or eccentric, or may be it is a driving-box running hot.

I am an extra engineer. Last month I caught Engine 312 for six (6) days while the regular engineer was laying off. He came to me, when he knew that I was going to have his engine while he was off, and told me that the left main pin was running very hot, and asked me to take good care of it and not burn it up. I told him I would do the best I could for her. He said it had been scraped and reduced, but that did not seem to do it any good. On the first trip that I ran her, the pin was so hot after a run of four (4) miles that I could not hold my hand on it, and I thought that it was time to apply a little of Dixon's Graphite, which I did, and the pin did not get any worse that trip. On the next trip I put a little in the cellar on the under side of the strap, and the pin did not get as hot as usual, although I ran her as fast as she could turn her wheels on a fast freight train; and when I got to the terminal, a distance of 73 miles, I could hold my hand on it with ease—it would not burn my hand.

After I had doctored it with Dixon's Graphite for six days, she ran cold, and has not given any trouble up to this writing.

Now, some one might ask the question, How is it for valves and cylinders? My answer is this: If you have an engine that handles hard from friction, or one that the valves and cylinders are continually groaning, try Dixon's Pure Flake Graphite, put in at the relief valves, or through the suction cups on your lubricator, and by a steady use of Graphite for a short time in this manner, I will guarantee that the groaning will stop, if the piston is not dragging on the bottom of the cylinder. I have shut off my lubricator and gone out on the steam chests, and put into the steam chests and cylinder a teaspoonful of Graphite mixed with a little valve oil, through the relief valves, when the engine was drifting, with throttle closed, and have run 51 miles to terminal without another drop of oil in my steam chests and cylinders, and my reverse lever handled as easily on the fifty-first mile as on the first.

Dixon's Pure Flake Graphite will save any engineer from worrying about hot bearings, but this is not the main saving; it will save oil, it will save material, it will make machinery run longer, and it will save the machinists from taking down 50% of the main-rod brasses that run hot on any road. Any man who has run a locomotive knows how a hot pin will throw oil, and how often he has to fill the rod-cups. A cool pin will not use over 20% of the oil a hot one will. O. A. POPE.

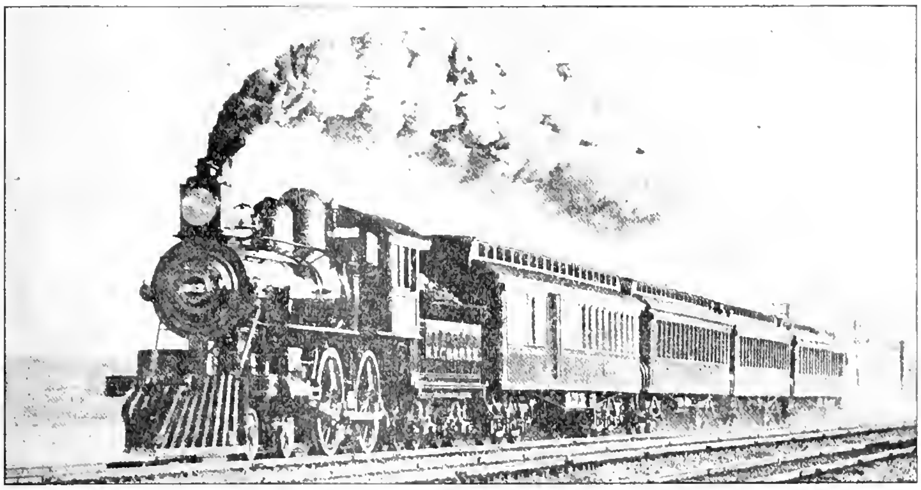
Hinton, W. Va., Sept. 19, 1895.

Have you seen our pamphlet with testimonials from "The Boys"?

JOS. DIXON CRUCIBLE CO.,

Jersey City, N. J.

"Two pairs, aces high."



The Fastest Locomotive in the World.

No. 999, Exposition Flyer, N.Y.C. & H.R.R.R.

Trial Speed, 112½ Miles an Hour.

It has a record made May 9, 1893, of running a mile in 35 seconds, being at rate of 102.8 miles per hour. Besides this, she has the record of the world for the long distance run made September 11, 1895, from New York to Buffalo. Total distance from New York, 436½ miles. Total time, 407 minutes. Average time, exclusive of stops, 64¼ miles an hour.

This engine was built by the N. Y. C. & H. R. R.R. Co., from designs by Wm. Buchanan, Supt. Motive Power.

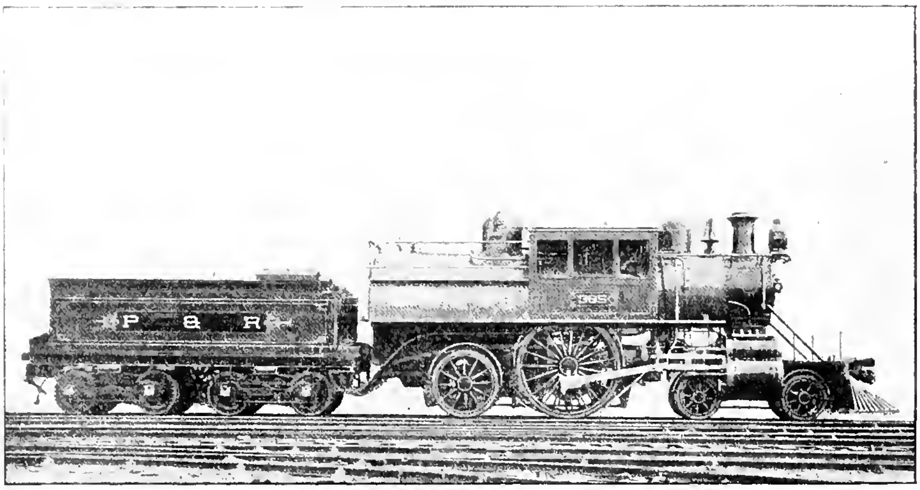
AJAX METAL is employed for all the bearings, and the engine started and ran cool from the beginning. After making a run of 440 miles without a break, the bearings were perfectly cool.

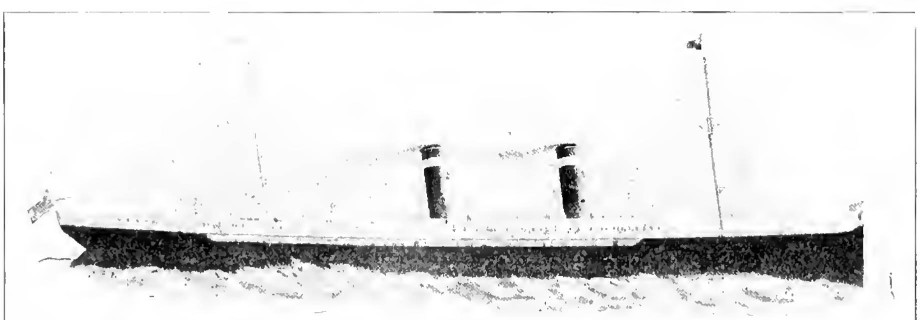
The Philadelphia and Reading Bicyle Engine, No. 385.

The Bicycle Engine recently planned by the Philadelphia & Reading R. R., and built by the Baldwin Locomotive Works, was taken from the shops on July 3, 1895, and placed in service on the New York Division on their fastest train, and has been in continual service ever since, until this date, September 1, 1895, without showing the least signs of heating the journals.

This engine is equipped throughout with our Celebrated AJAX METAL,

and has one pair of drivers, a rigid four-wheeled leading truck, and one pair of trailing wheels equalized with the drivers, the spring rigging being underhung. It has Vauclain compound cylinders and Wootten boiler for burning anthracite coal.





AMERICAN LINERS, ST. LOUIS AND ST. PAUL.

American Liners, S.S. St. Louis and S.S. St. Paul.

Trial Speed, 23 Knots per Hour.

The speed trial of the American Liner, Steamer St. Louis, over measured course in the English Channel, August 20, 1895, was a complete success. The time in which the course was covered was 4 hours and 41 minutes.

One of the officials of the Company stated that the trial was more than he had hoped for, he had not expected to receive such grand results. The machinery could not have worked better, there was no heating of the bearings, and not a single hitch throughout.

The revolutions of the engine averaged 95, and it is an interesting fact, that without taking account of the tide, the St. Louis went faster during the last hour than the first. This was the first time that the American or any other flag had ever been taken at that speed up and down the English Channel.

The Steamers are equipped throughout with our celebrated AJAX METAL.

The bearings were made of Ajax Tin and Copper.

The Ajax Metal Co.,

PHILADELPHIA, U. S. A.

WANTED.—Draftsman with experience on freight and passenger car work. State age, experience and salary expected. Address M. E., care LOCOMOTIVE ENGINEERING, N. Y.

WANTED.—A situation as foreman of Locomotive Repair Shop by a young man with years' of experience in both old and new work. Best references. Address X., care LOCOMOTIVE ENGINEERING, N. Y.

I will give **50 cents** each for the following numbers of LOCOMOTIVE ENGINEERING: Vol. 2, Dec., 1889; Vol. 3, Nov. and Dec., 1890; Vol. 4, August, 1891. Write before sending, OMAN L. POTT, JR., 25 Vinton St., Providence, R. I.

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2 " 32-inch Car Wheel Borers.
1 " 42-inch " " "
60 inch Pond Boring and Turning Mill (2 heads).
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No. 4 Garvin B. G. Miller.
No. 2 Brainard B. G. Miller.
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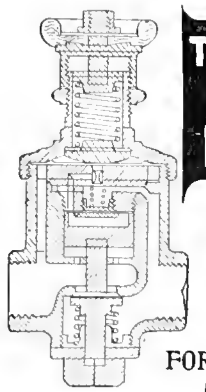

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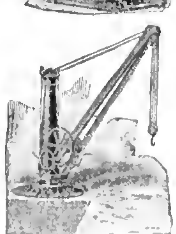

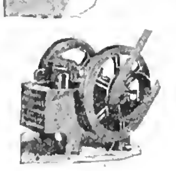

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Farrel's (Blake Pattern)
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Railroad Cranes
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Good little thing in this for agents—can't you sell 10 or 100?

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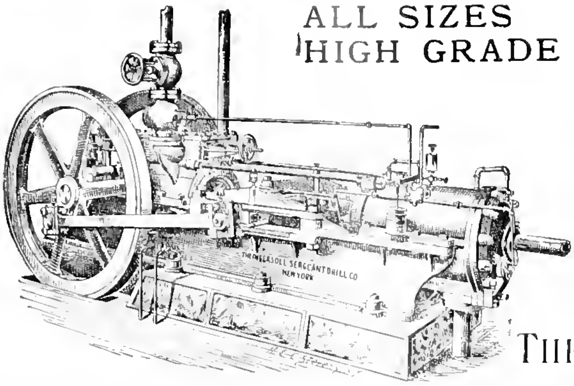

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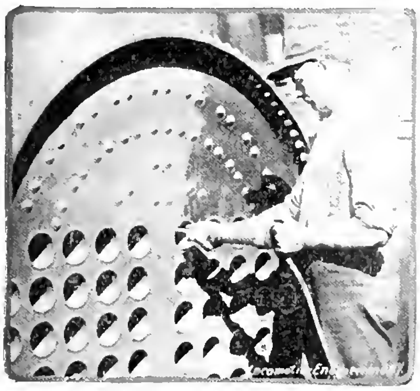

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CALKING BOILERS,
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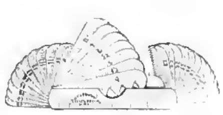

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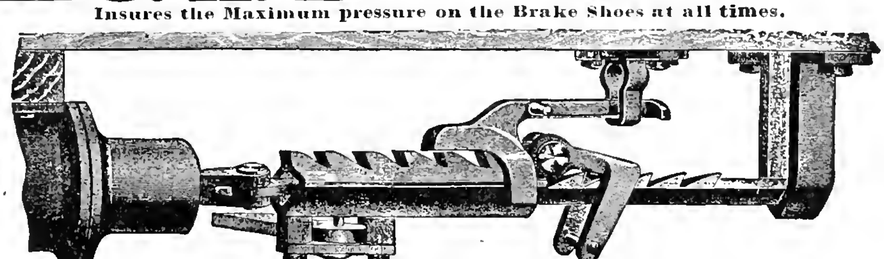

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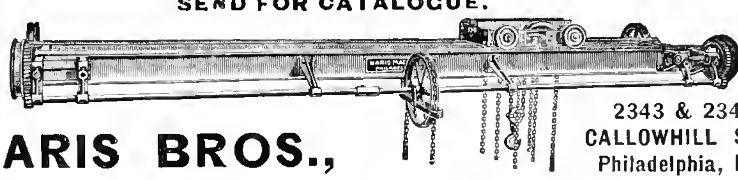

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Continued on page 723.

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ECONOMICAL in Use of Steam.

Takes less steam to operate it, has unusual range of delivery, and works equally well whether minimum or maximum quantity of water is required.

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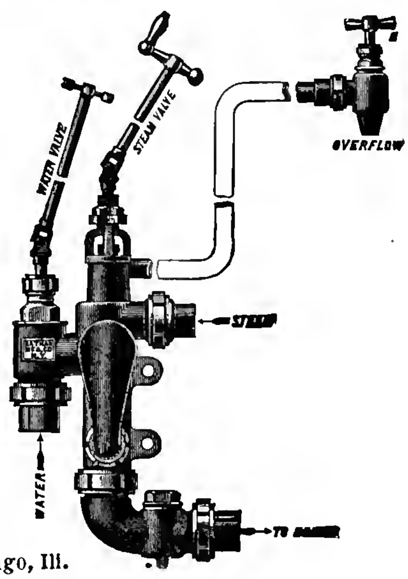

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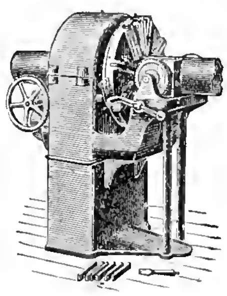

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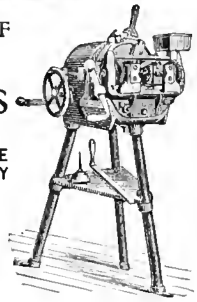

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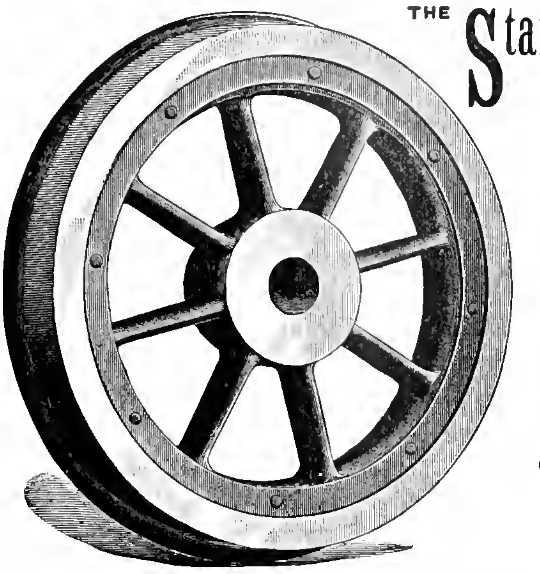

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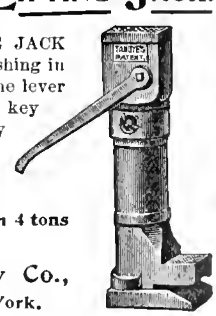

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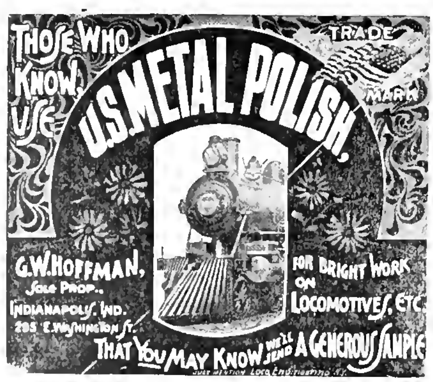

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Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co. New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia Pa
William Sellers & Co., Philadelphia, Pa.

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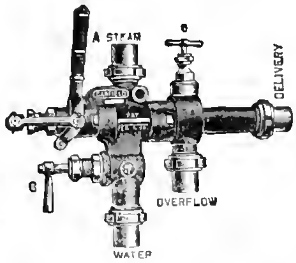
Continued on page 725.

The Detroit Improved Standard Garfield Injector



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Has Widest Range of Capacity.

Handles Warmest Water.

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Interchangeable with Other Standard Machines.

DETROIT LUBRICATOR CO., Detroit, Mich.

TAYLOR BEST YORKSHIRE STAYBOLT IRON

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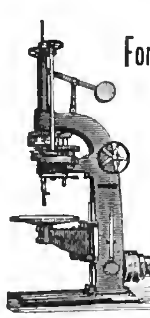

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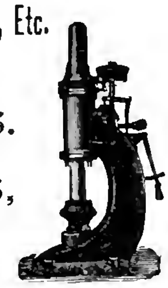

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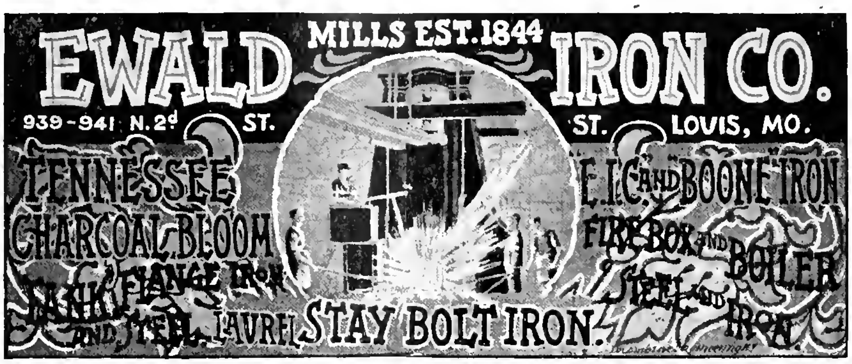

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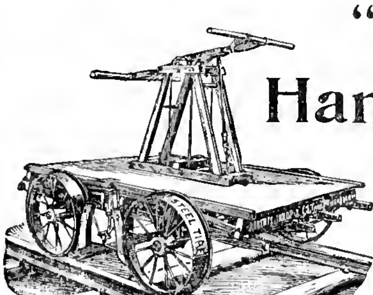

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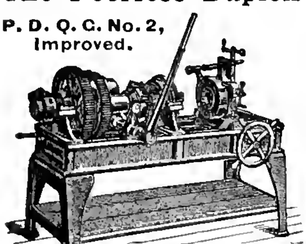

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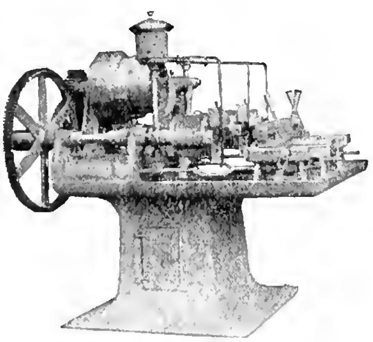

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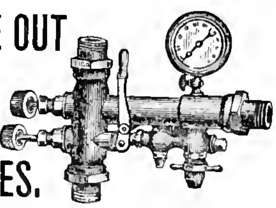

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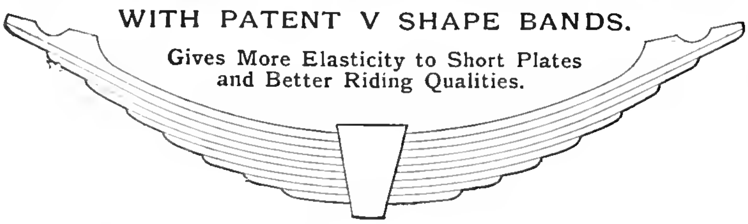

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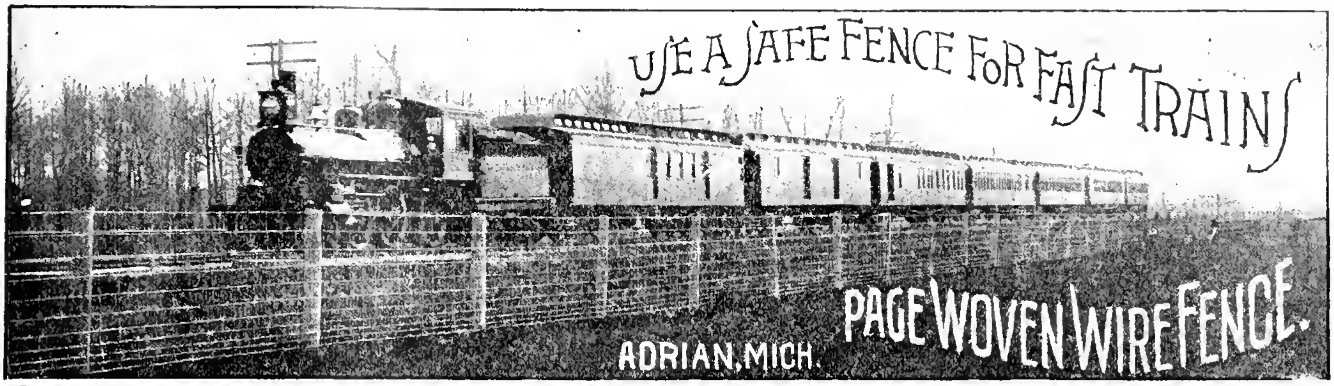

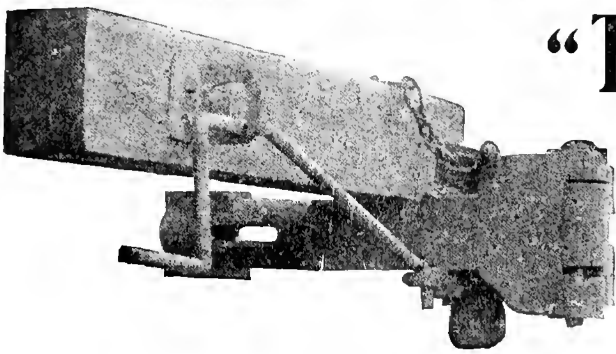

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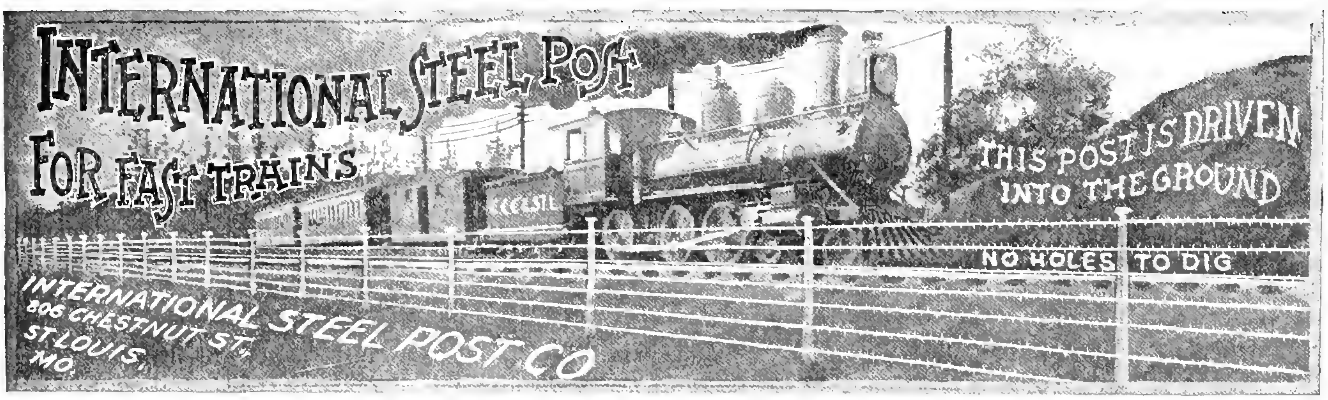

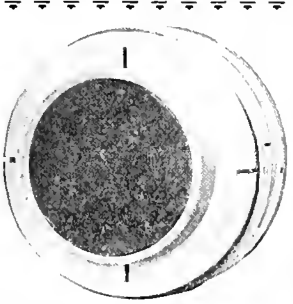

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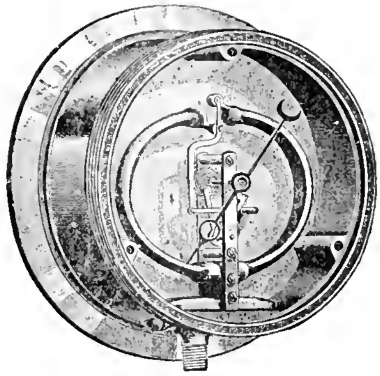

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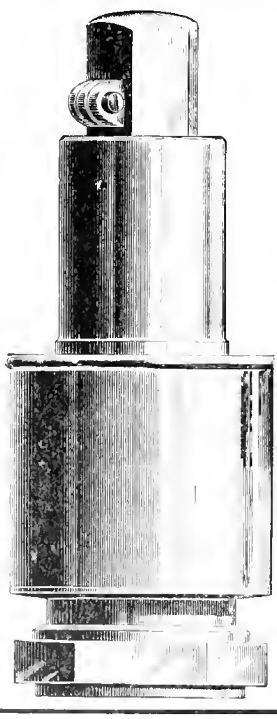

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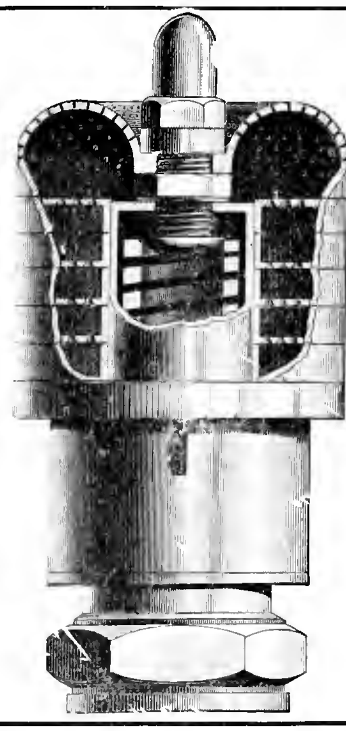

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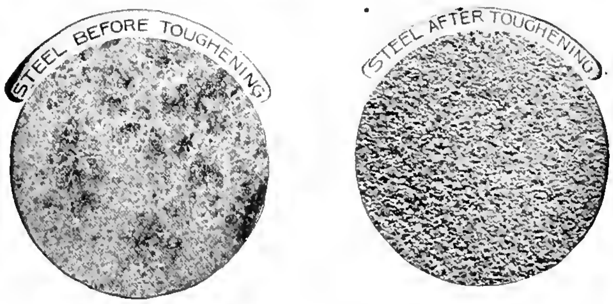

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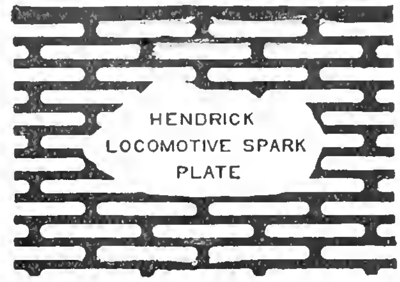

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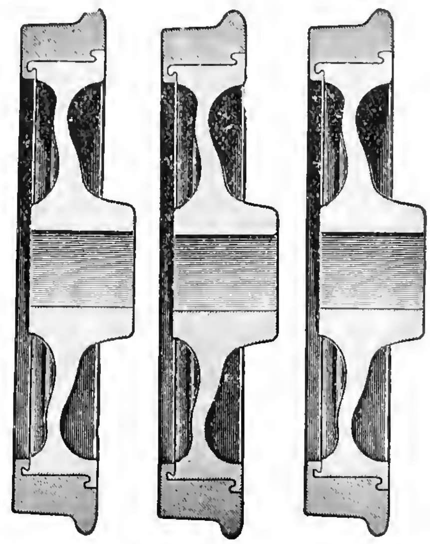

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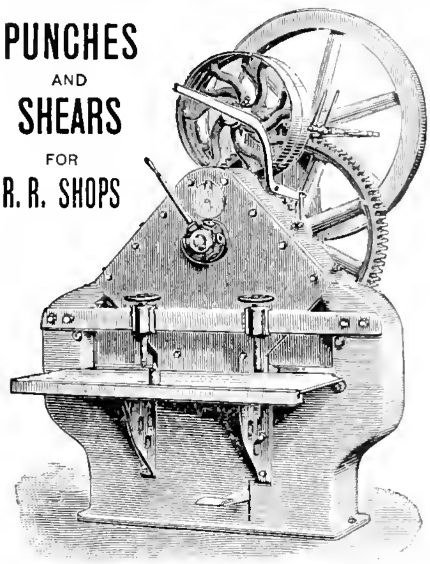

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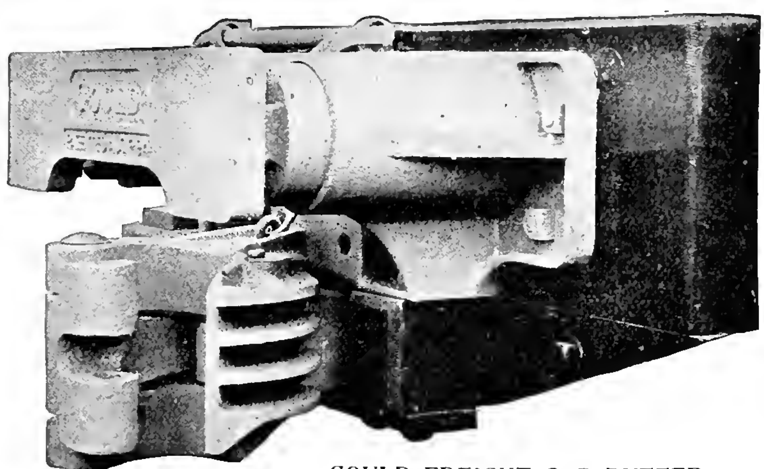

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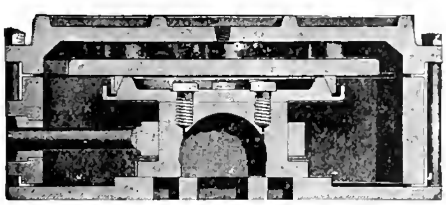

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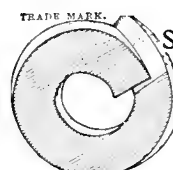

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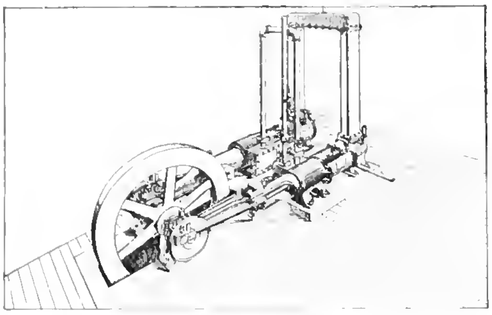

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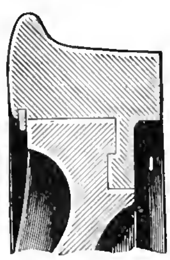

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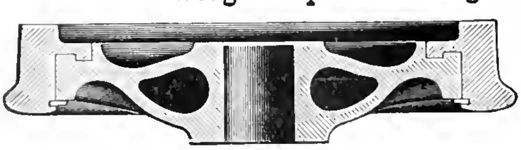

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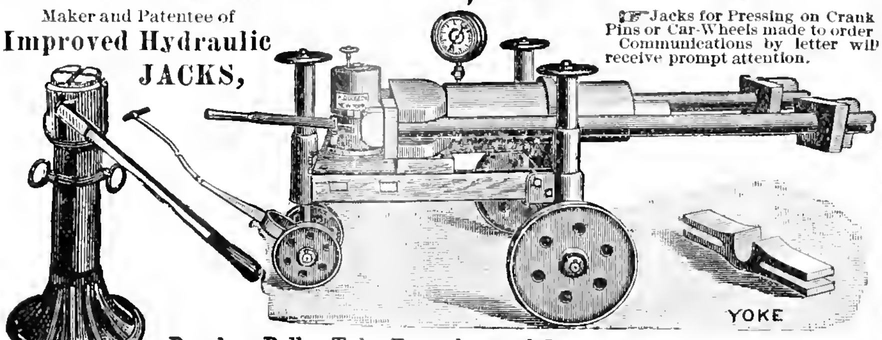

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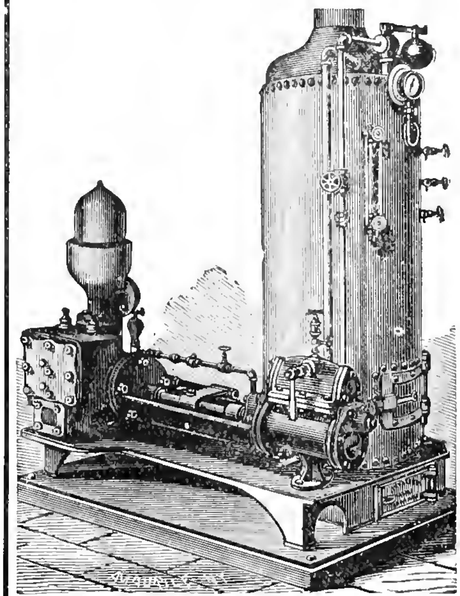

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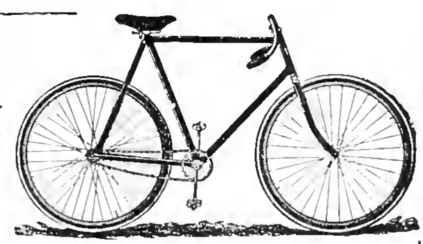

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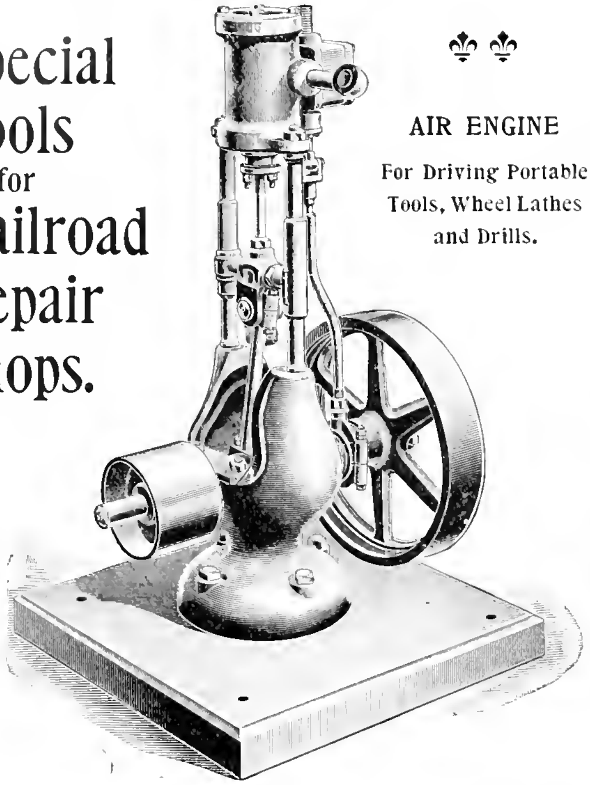

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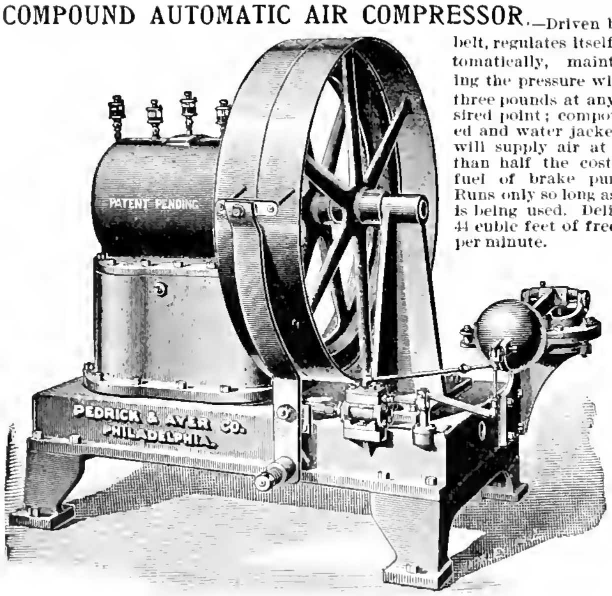

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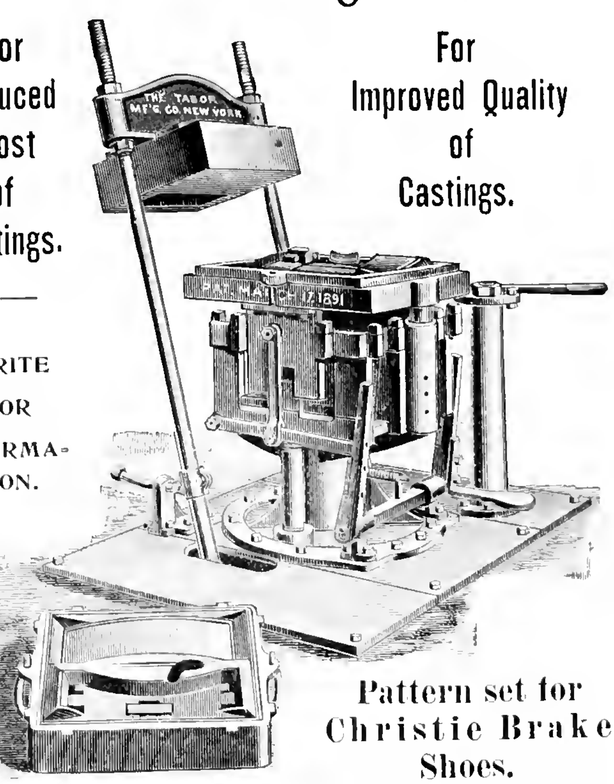

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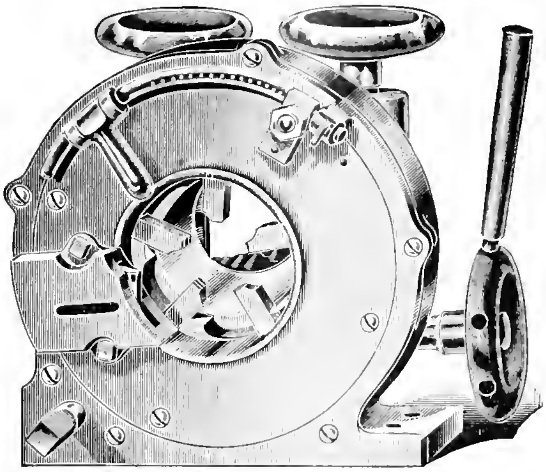

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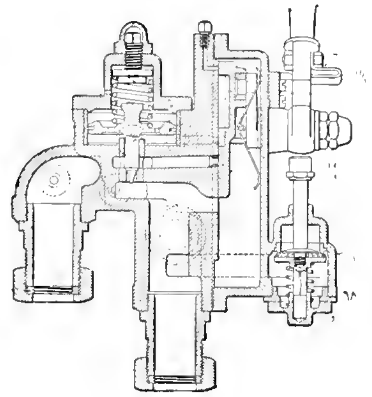

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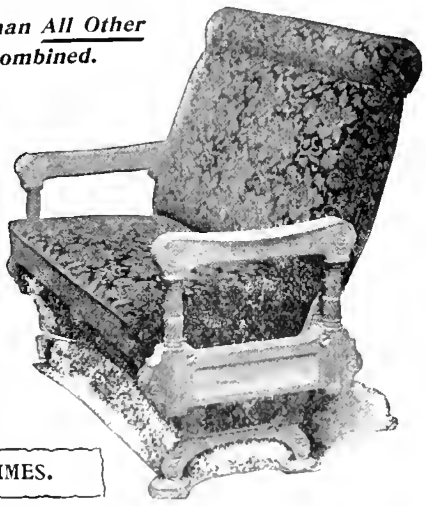

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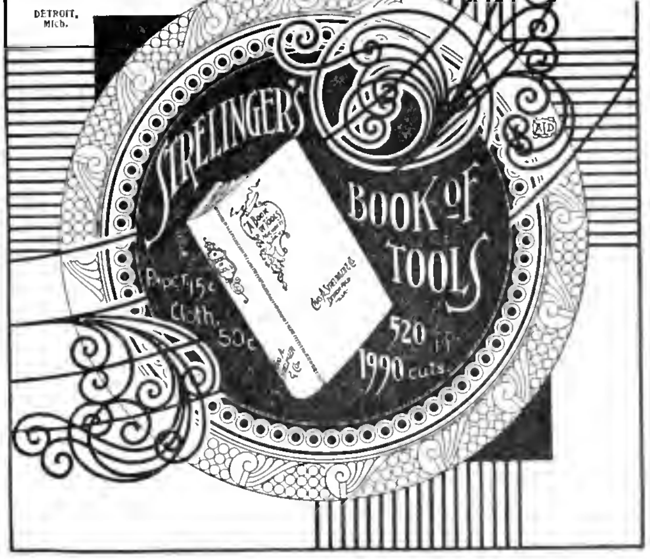

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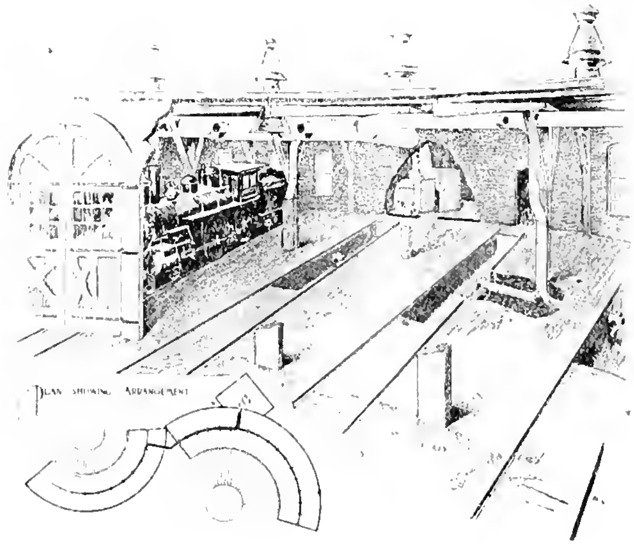

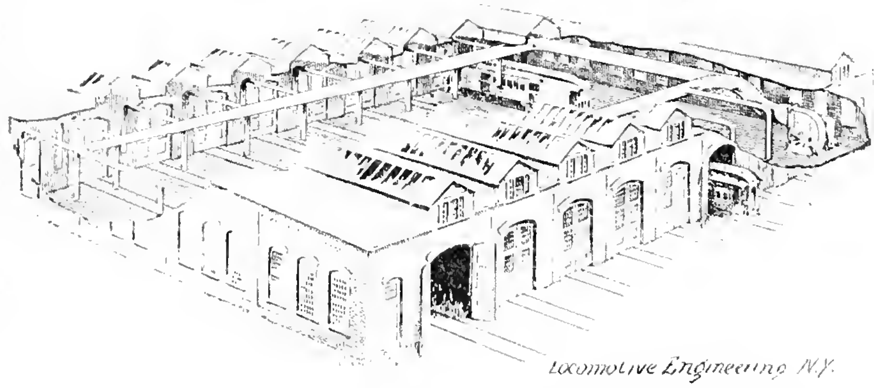

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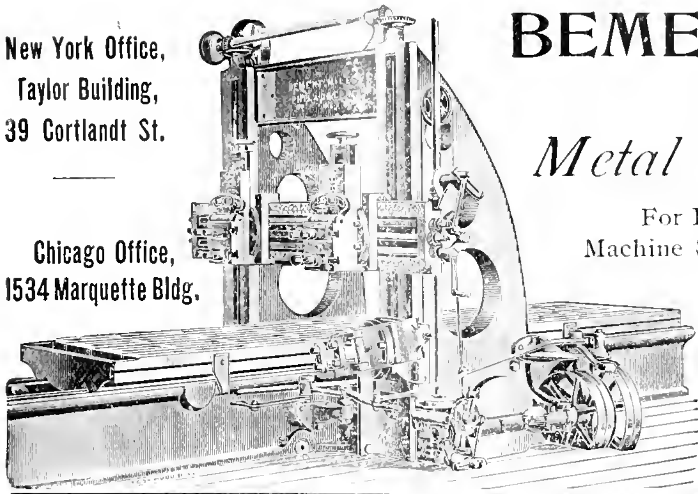

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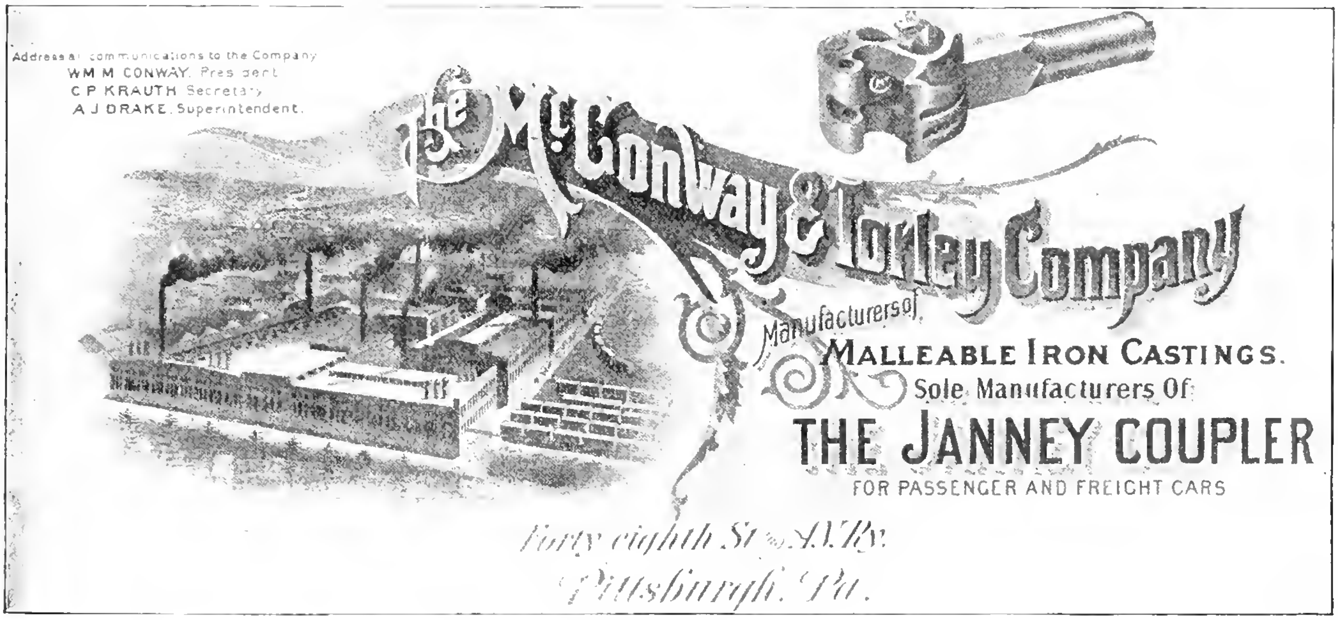

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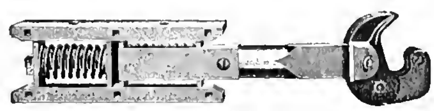

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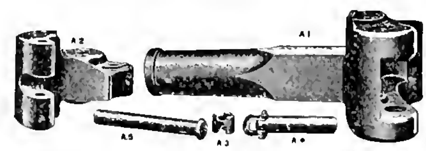

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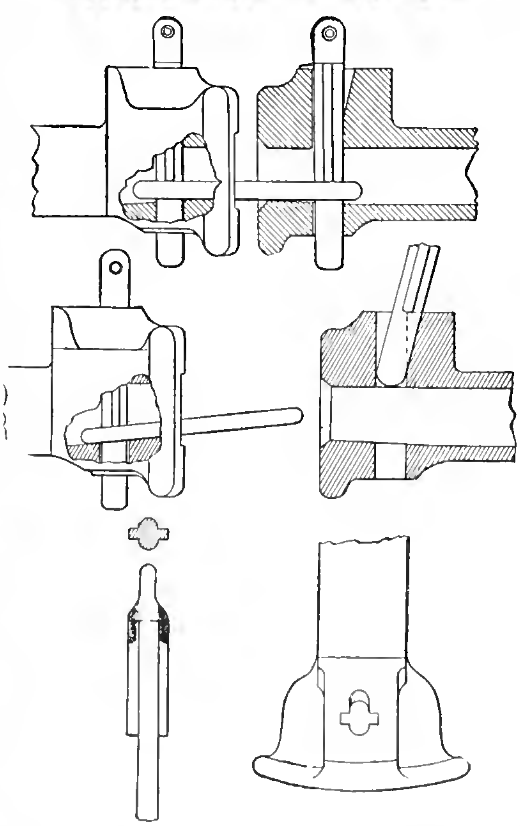

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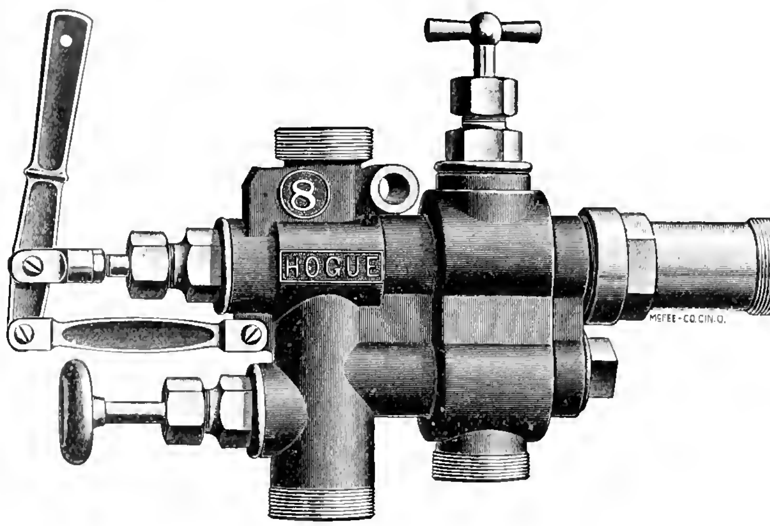

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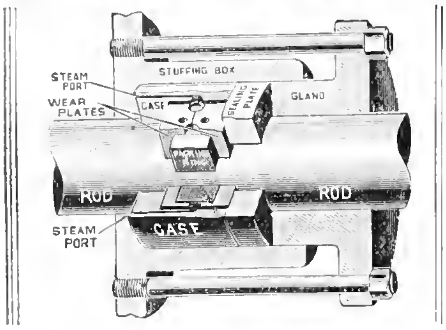

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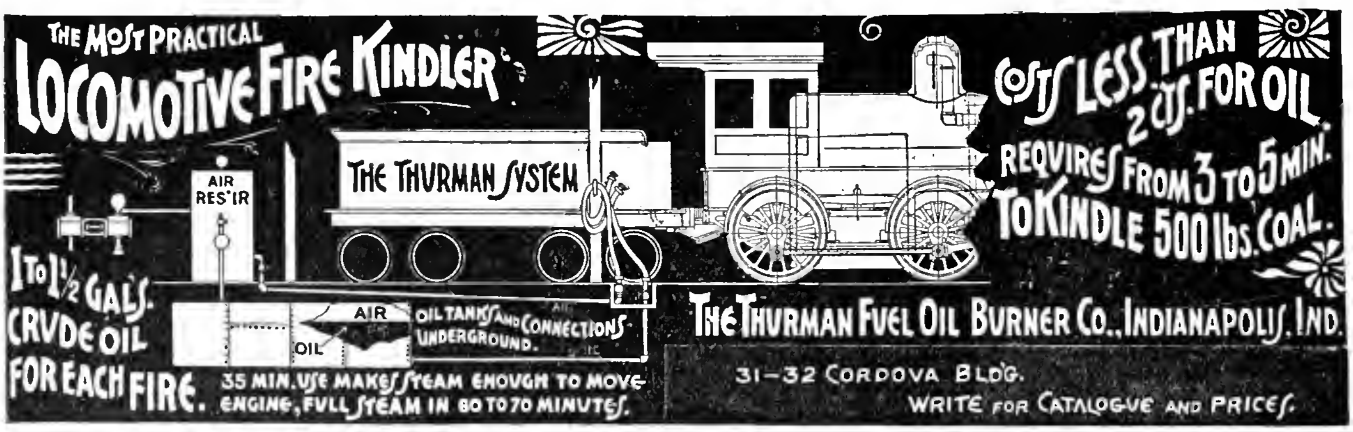

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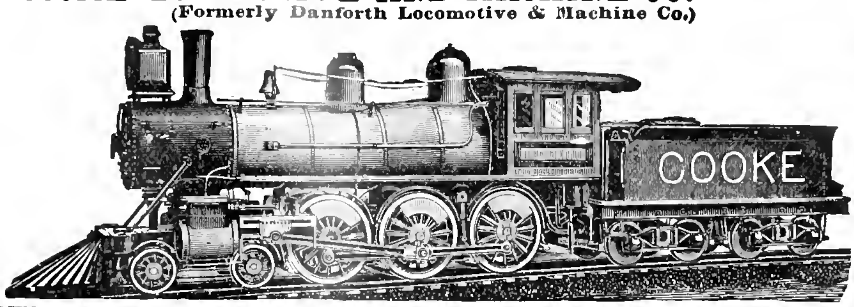

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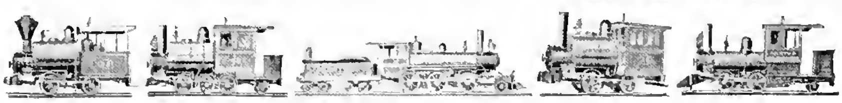

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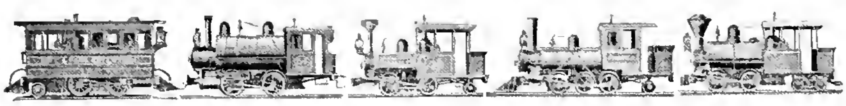

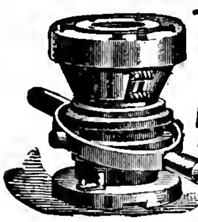

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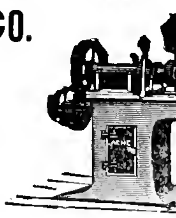

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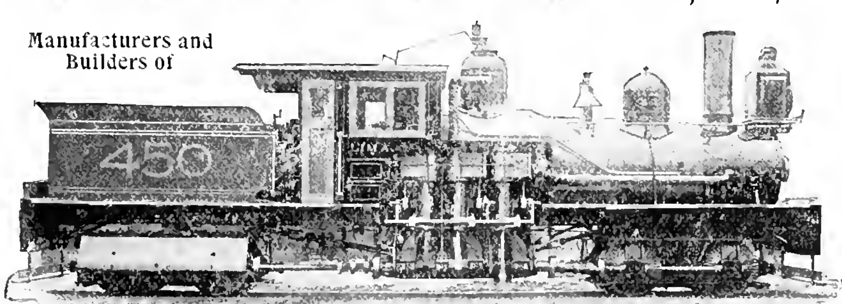

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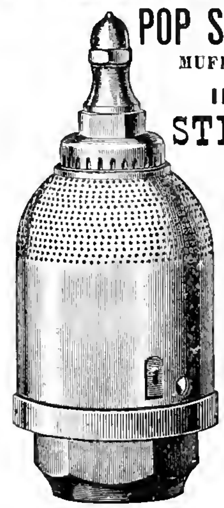

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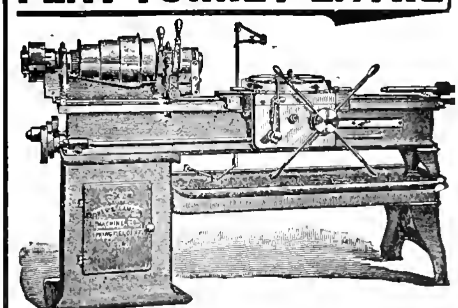

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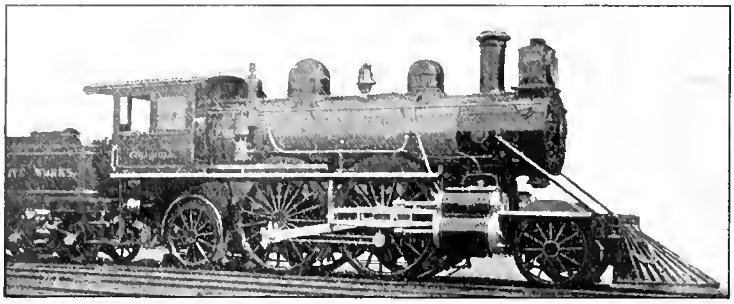

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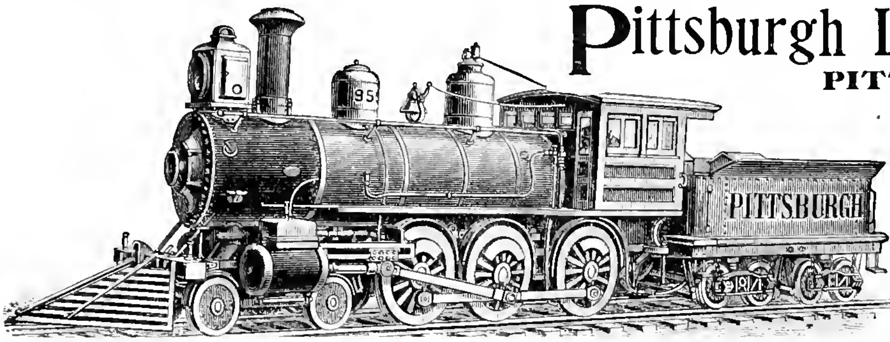

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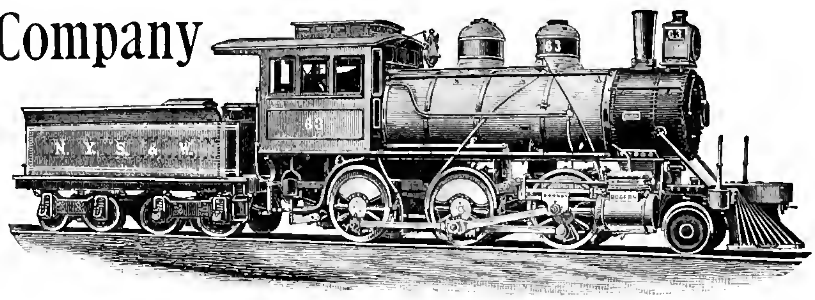

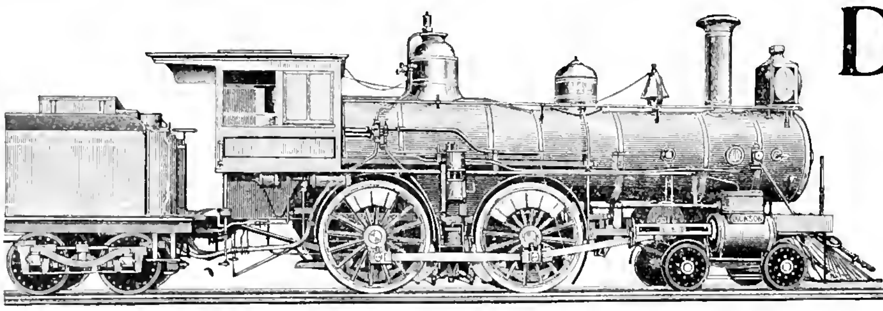

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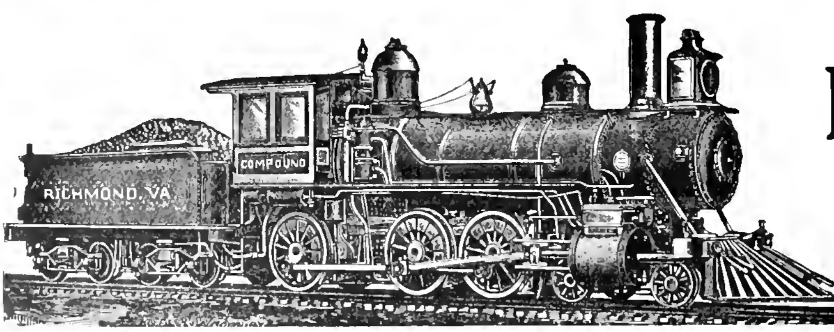

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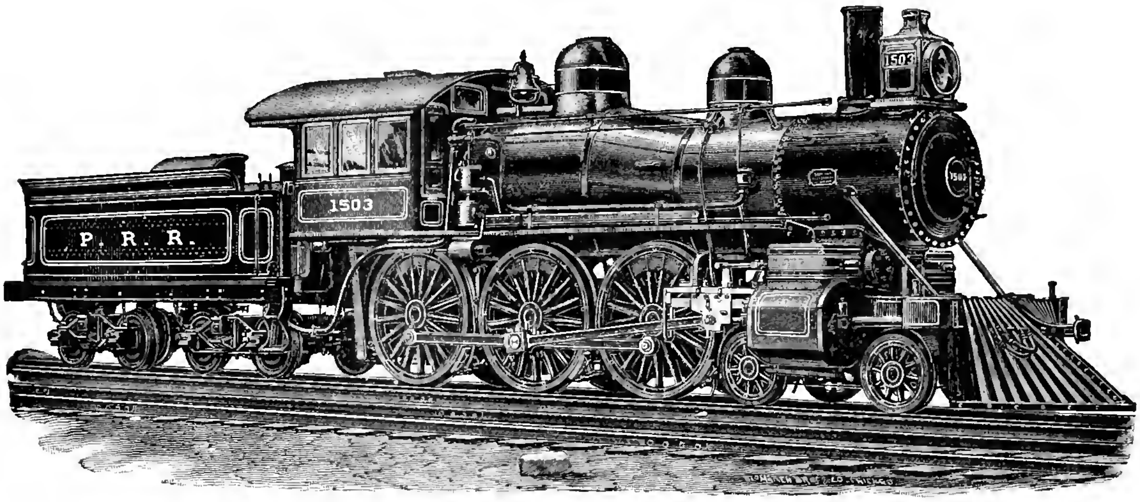

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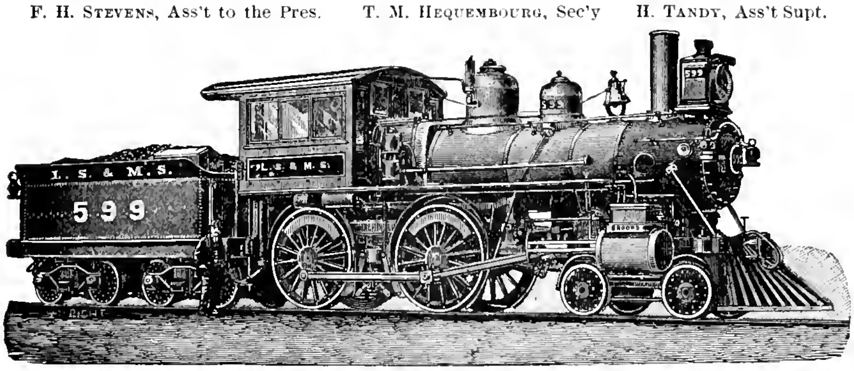

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Cash must accompany order. No books sent C. O. D. Give name of book and author, and we can furnish any book wanted. The list below is especially recommended for mechanical readers. All books sent by mail free for price named, unless otherwise stated.

Air-Brake Catechism. Conger. 1895. This is Conger's "Air Brake and Signal Instructions" rewritten and improved, containing the air-brake and signal instructions approved by the Master Car Builders' and Master Mechanics' Associations; also the standard list of questions for air-brake instruction. This is the latest and best book on air brakes. Issued November 1, 1895. Price... **25c.**

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Engineer's Catechism. Fowler. 1893. Especially for stationary engineers, and good. **25c.**

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Enginemen's Guide, Time and Pocket-Book. Kinne. 1892. Rules of procedure in a breakdown, for handling air, etc. Contains a time book. Good for three years. Bound for pocket.... **$1.00**

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Evolution of the Air Brake. Synnestvedt. 1895. A brief but comprehensive history of the development of the modern railroad brake, from the earliest conception contained in the simple lever, up to, and including, the most approved forms of the present day.......... **$1.00**

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Indicator Practice and Steam Engine Economy. Hemenway. 1892. The simplest and best treatise on indicating.......... **$2.00**

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Slide Valve Gears. Halsey. Third edition. 1894. The plainest book on the slide valve. Full of diagrams, but no mathematics.......... **$1.50**

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Steam Boilers. Wilson. 1888. On the designing of boilers. The standard authority on the subject.......... **$2.50**

The Engineer's Epitome. Smith. A collection of Facts, Figures and Formulas. Things that a stationary engineer should know. Ways to figure out everything.......... **50c.**

The Mechanical Engineer's Pocket Book. Kent. 1895. A reference book of rules, tables, data and formulæ for the use of engineers, mechanics and students. The latest and best pocket book. Bound in soft leather, with flap. The author has verified every rule and table used, brought the whole work up to date, and covered the field more completely than has any previous author.......... **$5.00**

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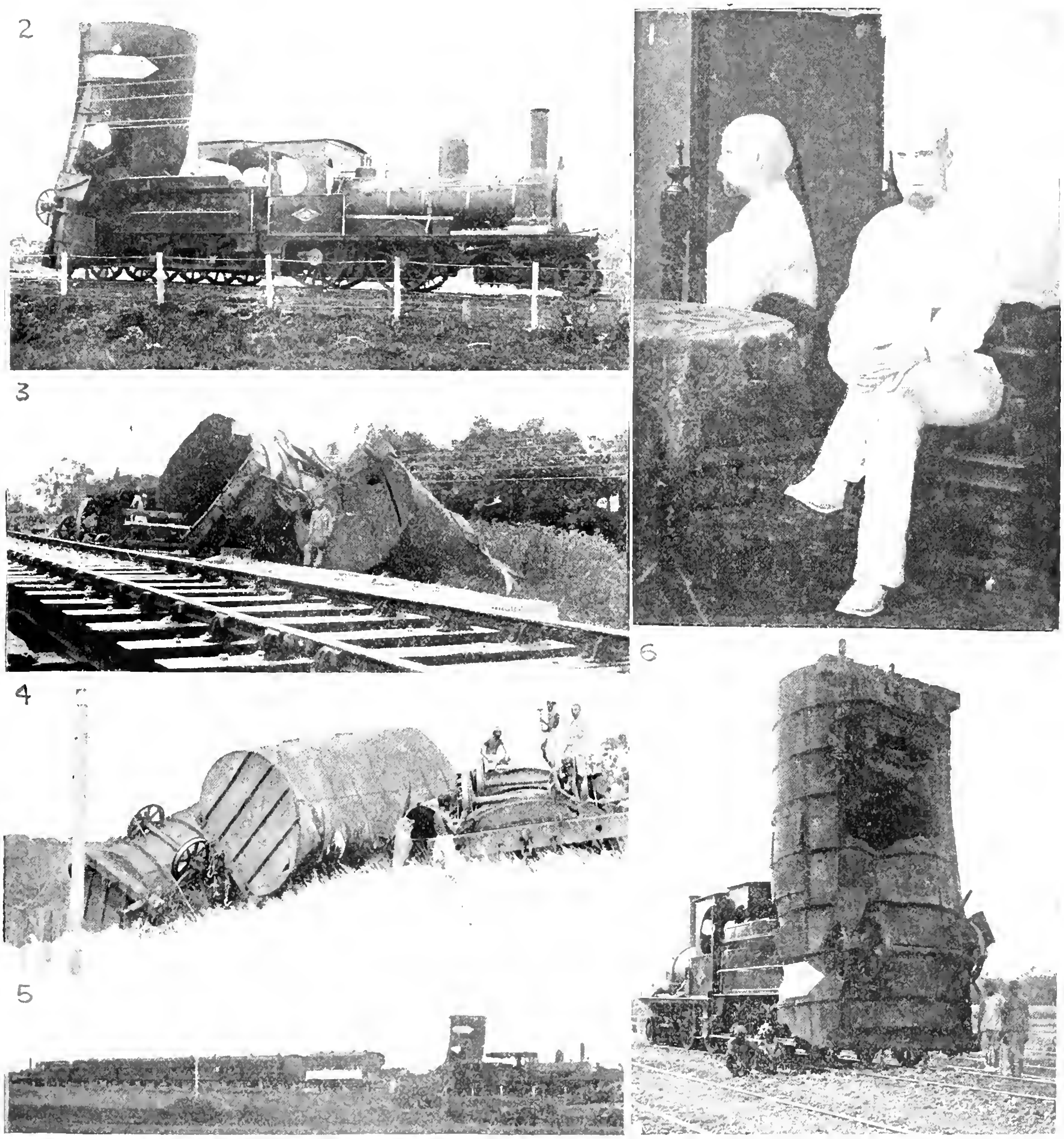
[Trade Mark Registered]

Vol. VIII. 256 BROADWAY, NEW YORK. No. 12.



AN INDIAN RAILROAD WRECK.

1. Walter Lodian, in Chinese costume, with a copy of LOCOMOTIVE ENGINEERING. 2. Wreck on Eastern Bengal State Ry., taken from cab [illegible]. 3. Some of the "Goods Wagons." 4. Wreck Crew at Work. 5. From a Distance. 6. "Pun[illegible]."

An Indian Wreck.

We present herewith some reproductions of photographs of a wreck that occurred on the Eastern Bengal Railway, in India, on the night of August 3d last—a head-end collision. The pictures were taken by Romes Chandra Sen, of Calcutta, and sent us by Mr. Walter Lodian, whose picture is shown in the full-page illustration.

The wreck pictures tell the whole story—show the kind of rolling stock and people of that far-away spot in Hindustan.

Lodian is a character. He is a native of the "land of steady habits"—a Yankee—but was reared and educated in Spain and France. He is a nomad, and this paper has received letters and pictures from him from all parts of the earth—first from Argentina, then France and Spain. Next he appeared in New York; he took in the United States pretty well for a year or two, and started for Siberia, "around the back way."

He sent us some items from Marshall, Mich. Next heard from Taylor, Tex.; then San Francisco. He sent in some pictures of railroad scenes in Hawaii, then from Australia, and now from India.

He writes that he leaves Calcutta for Vladivostok, Siberia, where he will winter, crossing Asia and Europe next summer.

He seems able to get from place to place and live with little money, and adapts himself to all kind of circumstances, as is evinced by his Chinese garb in our picture. He says he could "get along" better this way; that the paper-soled shoes and the pigtail are all right; but that he couldn't bear to part with his Uncle Sam goatee, but shaved his face and head—when in Rome he does as the Romans do.

Lodian seems to have a sort of affinity for shops, and visits all kinds of places where work is done, apparently for no other object than to see things. If he keeps a diary and observes right, some magazine may make up a trip out of him the next time he shows up here, as "Our Special Correspondent Sent Around the World at Great Expense."

A Curious Railway Accident.

On October 22d an express train on the Western Railway of France dashed into the Paris terminal (Montparnasse station) at thirty miles per hour, swept away the heavy bumpers, crossed a wide end platform and struck the stone wall of the station, tearing out all the wall below one of the large windows—wall 6 feet 6 inches high and 31 inches thick—then crossed a wide terrace and tore down thirty feet of a stone balustrade, and stopped with her nose on the pavement thirty-three feet below. The tender and first car were left as shown.

The tracks into the station are down grade, yet the train shed is elevated—the city is in a valley.

The only person injured was one woman in the street, killed by a flying stone.

The driver and fireman jumped off on the end platform inside the station.

The engineer claims that the Westinghouse automatic brake was working all right until he went to stop in the station; but this was disproven, for the brakes worked on the train just as they stood in the station, and, in fact, the accident was made as light as it was, in all probability, by the conductor applying his emergency brake when he found the train dashing into the station at such speed.

It was probably another case of frittering away air in numerous slight applications just before the final stop; or, what is more likely, forgetting to apply until too late—driver thinking of something else.

A Curious Railway Accident.

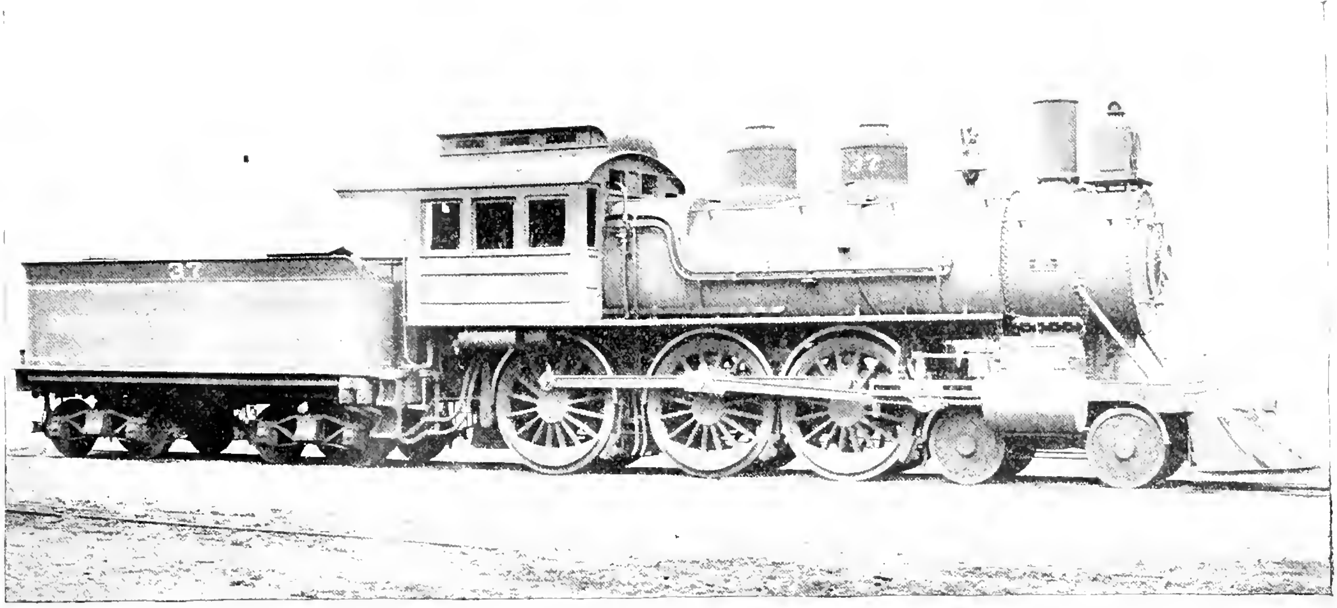
Our engraving was reproduced from the pages of *Engineering*, of London.

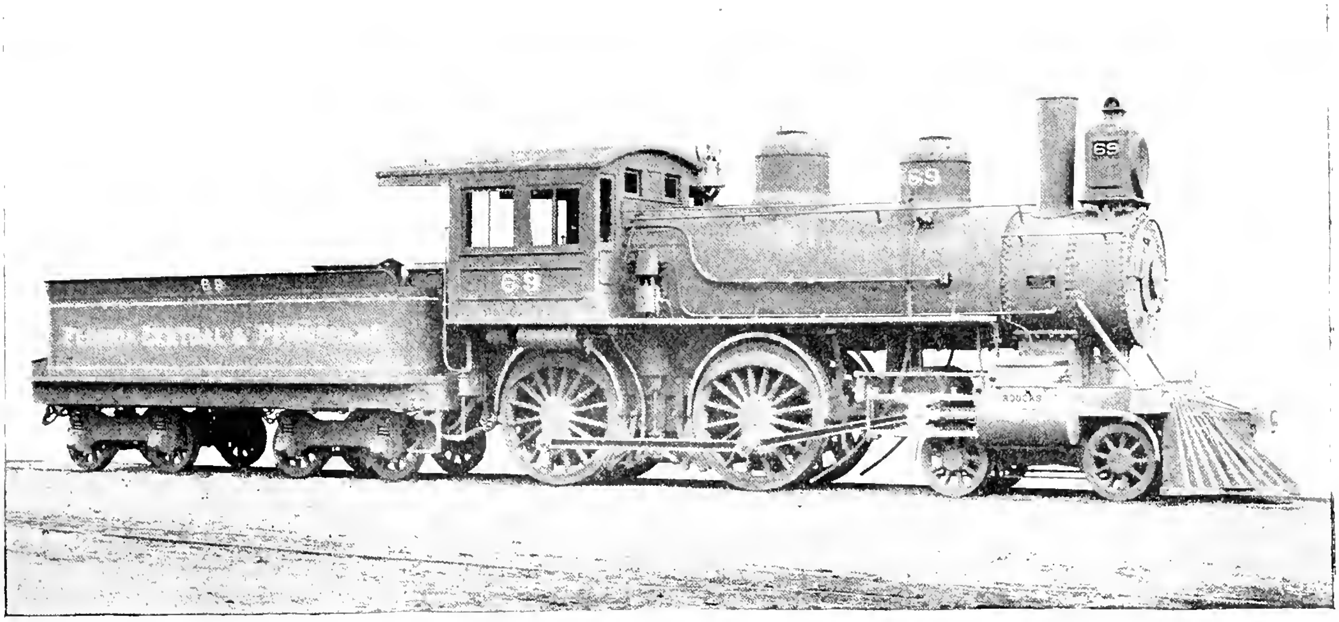
Early Wide Fireboxes.

A correspondent who is one of the oldest employés of the Pennsylvania Company claims that we were mistaken in saying that Millholland, of the Philadelphia & Reading, was the first designer to build locomotives with fireboxes above the frames. He submits a pamphlet, giving details of all the locomotives on the Pennsylvania Railroad in 1867, in which several locomotives built by Vancleve & Co., of Trenton, in 1852, had fireboxes 43 inches wide. Fireboxes of that width could not, of course, go between the driving wheels. Our correspondent also claims that some engines called "Monsters," built at Trenton about 1837, had fireboxes that extended over the frames. [The first "Monster" was started in Hoboken in 1833 and finished in Bordentown, where all the rest were made in 1835—her firebox was between the wheels and above the frames.—Eds.]

The Utica Steam Gage Co., Utica., N. Y., are giving away a very pretty charm for a watch chain, which consists of a steam gage in miniature. Any person sufficiently interested can have one by applying to the company.

We are entirely out of June, 1895, copies.





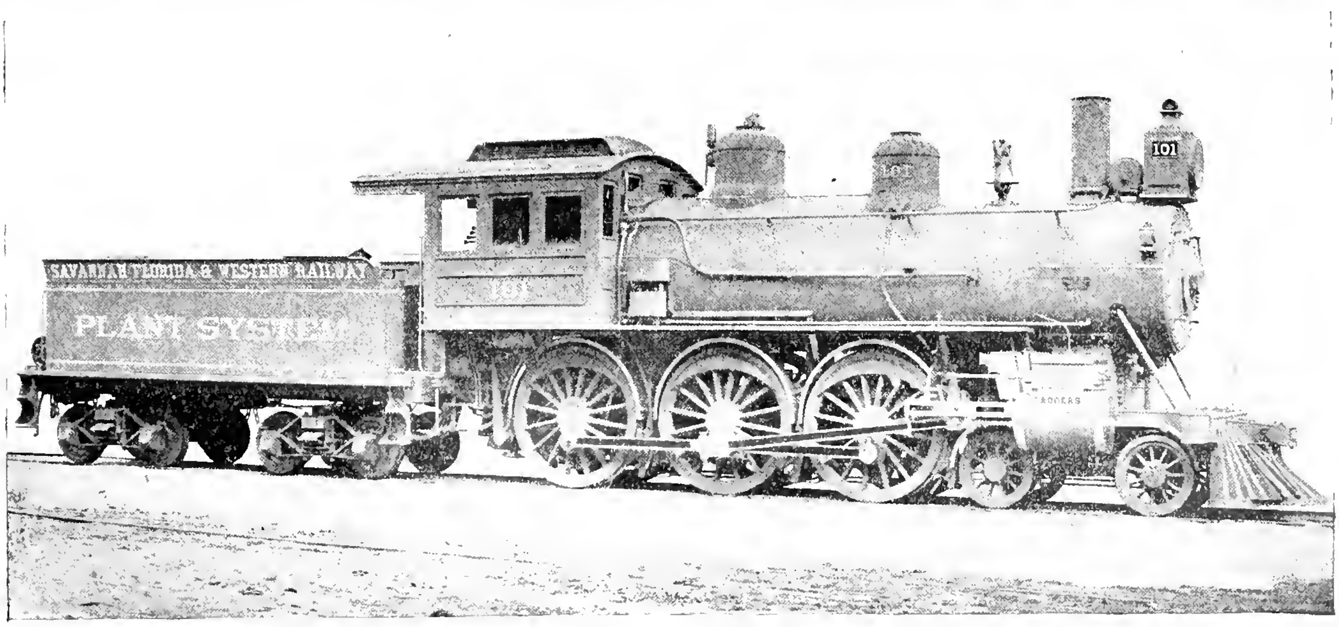
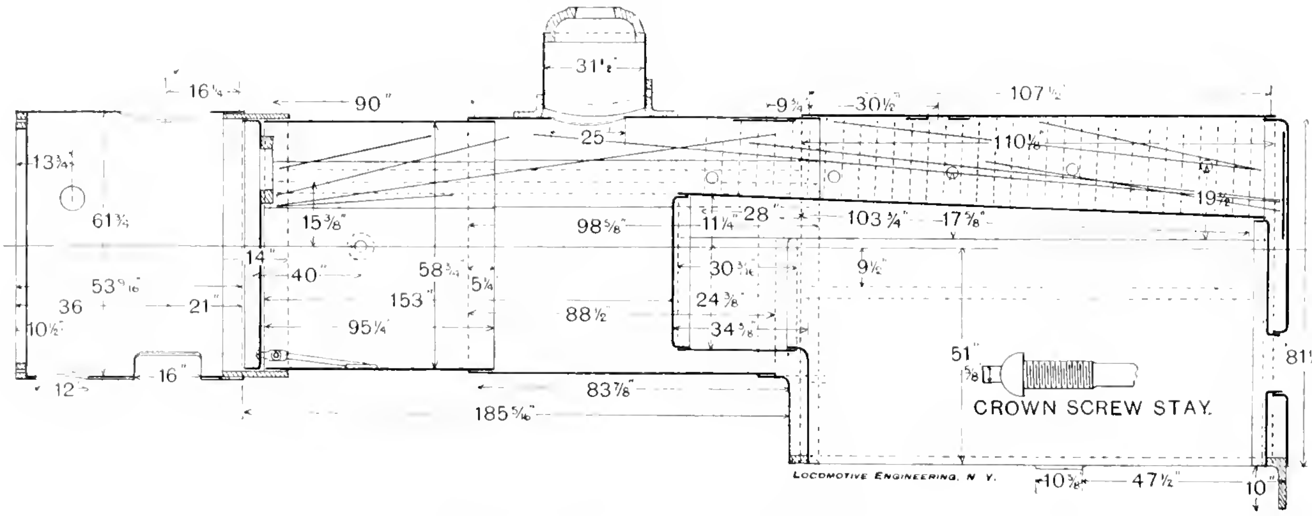


EXHIBIT OF THE ROGERS LOCOMOTIVE CO., AT THE ATLANTA EXPOSITION.

A New Type of Express Locomotive Designed by the C., B. & Q.

The first engine of the latest design of locomotive for express service has recently been put to work on the C., B. & Q. road. This locomotive, designated as the "590," has some entirely new features, the principal one being in the introduction of a moderately wide firebox above the frames, over the trailers and back of the drivers.

This construction admits of the use of an ideal boiler—something not true of all designs of locomotives.



BOILER, C., B. & Q. EXPRESS LOCOMOTIVE.

The running gear of the engine is the same as the "Columbia" type, now quite well known.

The only noticeable innovation in the engine is the use of piston valves.

The tender running gear is the usual one for six-wheeled affairs, but the tank is the Burlington standard, with more good features than one. In the first place, the coal space, sides and back, are on an incline, so that every ounce of coal slides ahead to the coal boards; no fine coal and cinders, soaked or frozen, to be shoveled ahead; the flange is high and around the coal space only. There is a roof over the front of the tank that is wide enough to protect the fireman but not wide enough to prevent getting coal into the tender; it is also low, so that it is easy for a man to get over it. The usual loose boxes are done away with and substantial iron cupboards located under the tender roof. A box for heavy tools is built inside of the back flange, the door opening on the outside of the flange—never anything in the way of getting out jacks, etc. The back end of the tank is surrounded with a hand rail, there being no flange. Large vertical tubes are set each side of the manhole—which is double width—to carry off water. No cross-braces used inside; sides stiffened by heavy angle iron. Gates are provided for each gangway and there is a comfortable seat on the left side of the tank for the fireman.

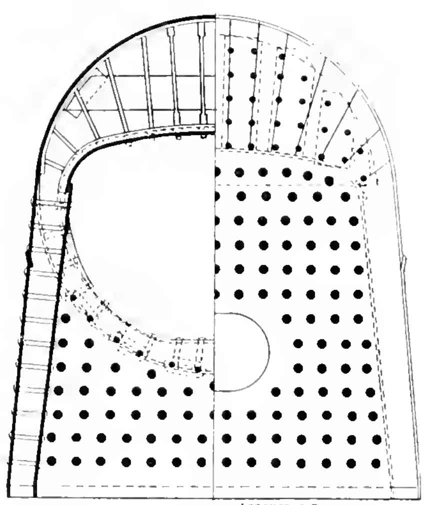
Our photographic reproduction shows up the engine in first-class shape, while the detail drawings show sizes and proportions. The following are the principal dimensions:

Boiler.

Maximum steam pressure, 200 lbs.
Type, straight radial stay.
Inside diam. smallest ring, $57\frac{3}{8}$ in.

Material, steel plates:
Firebox cover, $\frac{1}{2}$ in.
Barrel, $\frac{11}{16}$ in.
Tube, $\frac{1}{2}$ in.

210 tubes, No. 11 B. W. G., 2 in. outside diam. x 12 ft. 9 in. long.



Water space in legs, 4 in. wide.
Firebox, 5 ft. $2\frac{1}{4}$ in. and 4 ft. $9\frac{3}{4}$ in. high x 5 ft. wide x 8 ft. $10\frac{3}{4}$ in. long.
Material: Steel plates, $\frac{3}{8}$ in. thick.
Crown, $\frac{1}{2}$ in. thick.

Heating surface:
Firebox, 187.4 sq. ft.
Tubes, 1392.72 sq. ft.
Total, 1580.12 sq. ft.
Grate surface, 44.47 sq. ft.
Dome, 2 ft. $8\frac{1}{2}$ in. outside diam. x 2 ft. high, rising 1 in. thick.
Combustion chamber, 36 in. long.

Machinery.

Cylinders, 19 in. diam. x 26 in. stroke.
Steam ports, 21 in. long x $1\frac{3}{4}$ in. wide.
Exhaust ports, $25\frac{1}{2}$ in. long x 6 in. wide.
Steam-pipe section area, 25.9 sq. in.
Valves, piston type.
Maximum travel, 6 in.

Lead: Full gear, $\frac{1}{32}$ in.
Lap inside, 1 in.
Clearance outside, $\frac{1}{4}$ in. each end.
Radius of link, 5 ft. 2 in.
Centers of cylinders, transverse, 7 ft. 1 in.
Centers of valve stems, 3 ft. 9 in.
Centers of frames, 3 ft. 7 in.

Bumper beams:
Engine, 9 ft. 9 in. long.
Tender, 9 ft. 6 in. long.

Pins: Main, 6 in. diam. x 6 in. long.
Crosshead, $3\frac{1}{2}$ in. diam. x 3 in. long.
Pins—Side rods: Front, $5\frac{1}{2}$ in. diam. x 4 in. long.
Back, $6\frac{1}{2}$ in. diam. x $4\frac{1}{2}$ in. long.

Wheels:
Drivers (4), cast steel, $84\frac{1}{4}$ in. diam., with retaining rings.
Truck and trailing, cast steel, $50\frac{1}{4}$ in. diam.

Journals: Driving, $8\frac{1}{2}$ x 12 in.
Truck, $6\frac{1}{2}$ x 10 in.
Trailing, 7 x 12 in.
Main rods fluted, solid oil cups on all rods.

Weights—Engine in Working Order.

Front drivers, 39,600 lbs.
Main drivers, 46,600 lbs.
Total on drivers, 86,200 lbs.
Trailers, 31,800 lbs.
Truck, 20,000 lbs.
Total weight of engine, 138,000 lbs.

The engine has one $9\frac{1}{2}$ and one $10\frac{1}{2}$ Sellers injector.

West bell ringer.

Leach track sander.

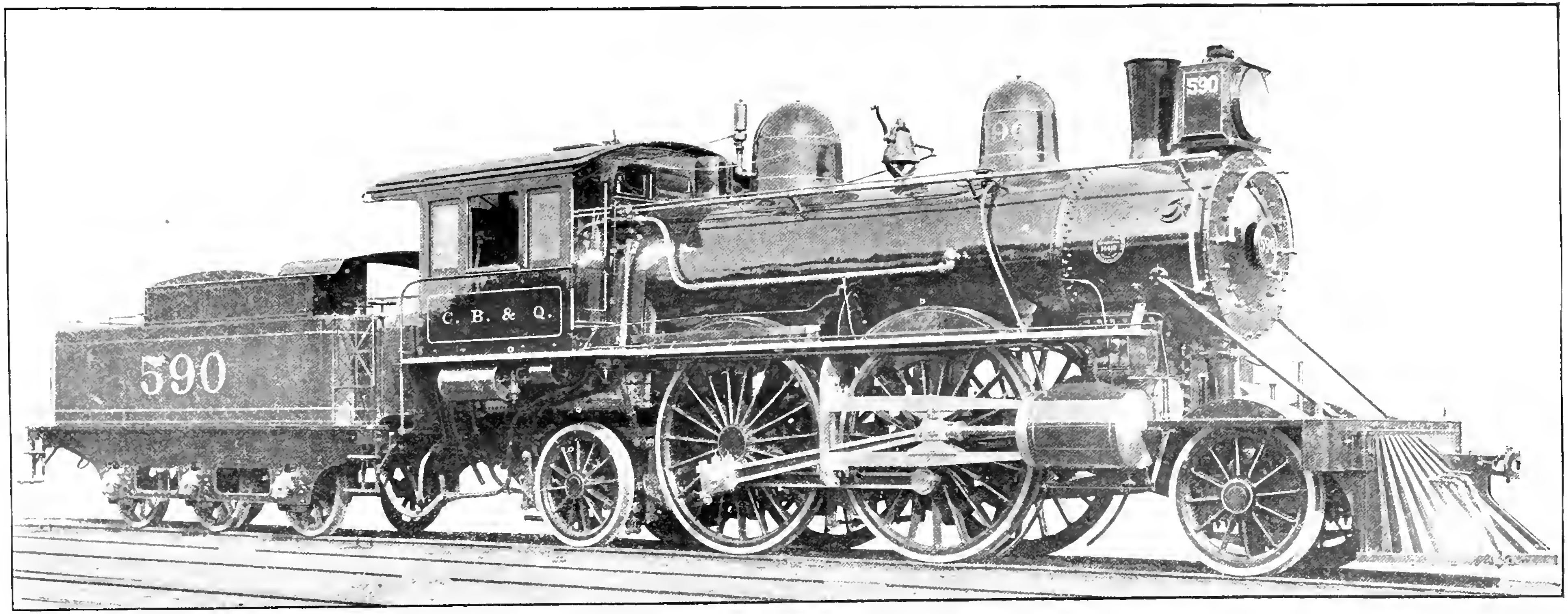
Nathan triple feed lubricator.

Westinghouse-American outside-equalized brakes on drivers and trailer, train brake and air signal.

Janney coupler on tender.

Especial attention has been paid to clothing the cylinders and steam chests, and the steam and exhaust passages are entirely separated in the saddles.

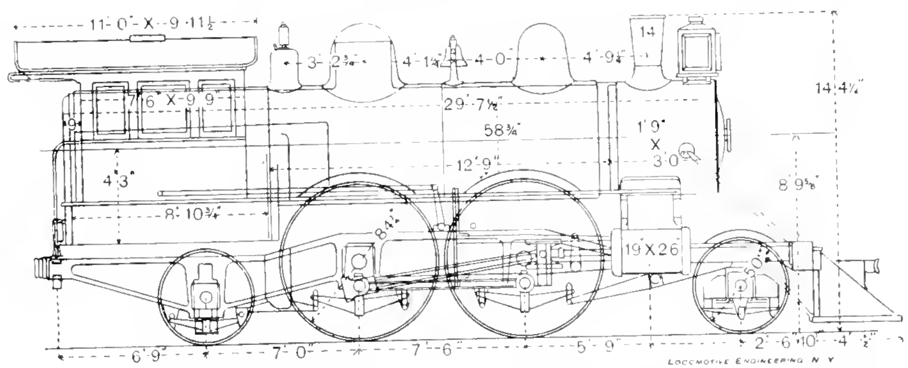
The jacket is of cold-rolled packeled



Designed by G. W. Rhodes, S. M. P.

THE C., B. & Q.'S NEW EXPRESS LOCOMOTIVE

Built by Baldwin Locomotive Works



steel, painted black and striped with the same.

The lagging of boiler is asbestos cement.

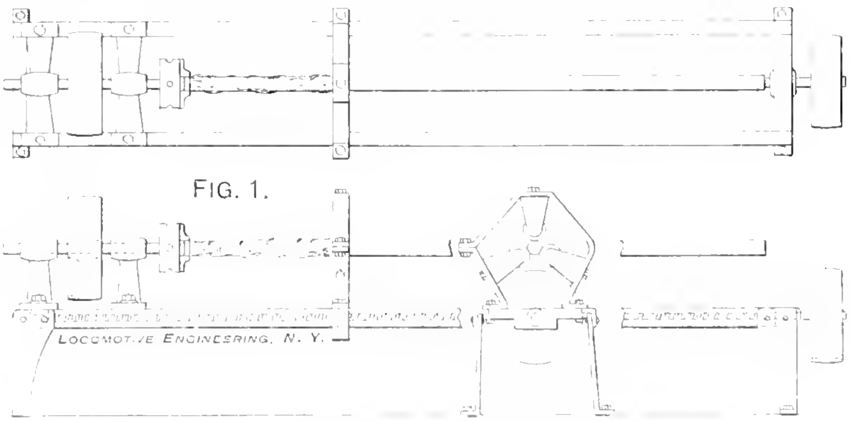
The "590" is a handsome machine and ought to make a record for herself and her designers.

On another page of this paper the Lodge & Davis Machine Tool Co., Cincinnati, O., offer to present a magnificent gold-plated 16-inch swing tool-room lathe to the technical or mechanical school in the United States receiving the greatest number of votes. We think the institution of this kind in the United States that is most deserving of this present is Purdue University, Lafayette, Ind. This institution makes a specialty of railroad mechanical engineering, has full-sized locomotives to aid in carrying out scientific investigations, and the faculty are always ready to help out railroad men with tests and experiments. We therefore urge our readers to vote for the Purdue University, and get as many of their friends as possible to vote the same way. The Lodge & Davis Machine Tool Co. will send voting blanks on application. Send for a blank for yourself and for each of your friends, and enjoy the consciousness of having done a good action for a deserving institution. Machine-shop foremen and traveling engineers ought to be able to influence hosts of votes. Those voting may have sons they expect to send to Purdue University, and they will benefit directly from the use of the fine tool.

We learn from a newspaper cutting that a prize of $150 has been awarded to D. F. Cornell, of Westfield, Pa., for an improvement in lathe carriages. The prize is the reward of John Wedderburn & Co., of Washington, a well-known patent firm, who give a prize of this sort monthly for the simplest invention brought to their attention during the preceding thirty days. It will interest inventors to know that Cornell was brought up on a farm, and had little experience in mechanical work when he invented the improvement which got him the prize.

Flue Cleaner.

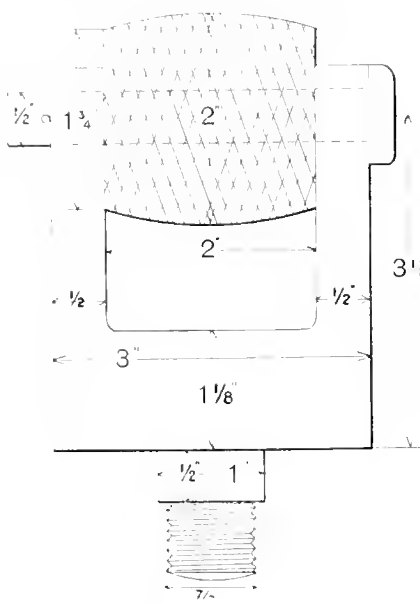
The best flue cleaner it has been our fortune to size up, was seen in the shops of the Kings County Elevated R. R., a creation of Mr. Wm. Thompson, the master mechanic. This little machine removes the scale in such an expeditious and businesslike way that one can't help but wish it were possible to turn it loose in a boiler, and see it wade through the incrustation there also. This is a home-made affair, made up of material lying around the shop, and, as usual in such cases, it is open to criticism in matters of detail, perhaps; but this is a point well understood by all pioneers in improvements, and does not necessarily affect the efficiency of the machine, which can get through scale down to the metal in a manner that is decidedly satisfactory, and that, too, in a noiseless way that is a shining example to the old nerve-destroying flue rattler.



FLUE CLEANER, KINGS CO. ELEVATED R.R.

The frame of the machine is made of two pieces of ½ x 2½-inch angle iron supported on four legs, and the latter are secured to the floor by lag screws, shown in Fig. 1. Fitted to this frame is a movable head, made to traverse the whole length of the frame by means of a 1¼-inch seven-thread screw, which has a pulley at one end belting from a countershaft, this screw working in a nut formed in the lower part of the head which is tapped to receive it. The head is made of ½ by 3-inch iron, and carries three hardened steel rollers 2 x 2 inches having serrated peripheries, and which revolve freely on ½-inch pins. Fig. 2 shows the arrangement of the rollers in the traveling head, and the method of securing the flue in place to be operated on. It is seen that the head is made to spring such an amount that, when bolted on one side only, the cutting rollers will be at a proper distance from the flue to clean it to the metal, and this amount of spring is adjusted by the bolt very nicely.

At the left-hand end of the frame, Fig. 1, are secured two bearings, in which works the driving mechanism; this consists of a shaft, on which is the driving pulley, actuated from the line shaft, and also a universal chuck which grips and carries the 1½-inch flues of these little engines. In operation the flue is placed between the cutting rollers and the end gripped in the chuck; the head carrying the cutters can be started from either end of the flue at will, and as the traverse or feed is entirely automatic, the whole thing does not entail much expense for attendance. The ease with which results are accomplished, makes some of the older and cruder methods of removing scale from flues appear ridiculous in comparison, and is an object lesson in attaining an end when a mechanic is on the trail.



ROLLER FOR FLUE CLEANER.

Tinning Pistons.

When a certain kind of material gives good results in one kind of service, there is a great inclination with the ordinary man to believe that it is good for universal use. Bad mistakes are frequently made by this free generalization. For example, the finest working locomotive crossheads we have ever seen had tinned surfaces bearing on the guides. The natural inference is that tin will make the best kind of wearing surface for any part having a reciprocatory motion.

There were some rather edifying facts brought out in a discussion in the Master Mechanics' Convention about the use of tin in pistons. In crossheads it had been an unqualified success, and a committee reported that where steel pistons were used it was customary to heavily tin the outer rim, where it bears against the cylinder. Mr. H. D. Gordon called for particulars of experience with this kind of piston. In response to this, Mr. E. F. C. Davis, of the Richmond Locomotive Works, spoke of their experience in trying to make the piston of the compound locomotive as light as possible. He said:

"We wanted to make the piston of something better than cast iron, so we used cast steel, made from the best 80,000-pound grade of steel. We assumed that the steel piston was not going to wear very well in the cast-iron cylinder, and our first scheme was to cut a dovetail groove in the middle of the piston faces, and fill that with tin or babbitt. That worked very successfully, and did not cut the cylinder at all, but the tin would break up by the change of temperature. So, after that we cast this ring of bronze—either Ajax metal or phosphor-bronze—turned up the piston, turned the groove in there, and took it in the brass foundry and cast this ring of bronze; but if cast in one piece, the shrinking would break it apart. We cast one section at a time, burning the ends of each section to its next preceding section, so that when the ring was complete there was no shrinkage to break it. Then that piston was put in the lathe again, and in turning it up the bronze ring was allowed to project $\frac{1}{32}$ of an inch beyond the face of the steel casting. When that piston goes into the cylinder, the pores of the cast iron and the pores of the steel are filled with bronze, or anti-friction babbitt metal, as the case may be, and it makes a very beautiful and durable wearing surface. It adds very little to the cost of the piston."

Took the Right Signal.

Tim Corcoran, track-walker, flagged the flyer, but in his excitement he gave all the signals in the code and several can-can contortions beside—the engineer stopped.

"Whatell kind of signal is that?" asked the plug-puller.

"Bejazez," says Tim, "Oi'm not much on signals, so Oi tho't Oi'd give yez the lot av 'em and yez cood take yer chice."

"Hope I chose the right one, anyway," said the engineer, laughing.

"Indade ye did, sorr; there's a bridge gone jest beyant the coorve forninst ye!"

The members of the New England Railroad Club have changed the time of the meetings from Wednesday to Tuesday evenings. This has been done to accommodate those who wish to attend the meetings of the New York Railroad Club on Thursday evenings.

A Road Locomotive.

Our picture shows a novel locomotive, used by Richardson Bros., of Truckee, Cal., in their logging and lumber business.

The mills are situated at the base of a mountain, and these engines climb the mountain with empty wagons, load up and bring them to the mills, a distance of 10 miles. The trip is made in five hours each way.

At night the wagons are loaded with lumber, and the engines make a night trip to the schooner landing on the Truckee River.

Each wagon carries from 3,500 to 5,000 feet of green lumber.

We do not know the size of the cylinders, but the engines are geared to make nine revolutions to the drivers' one, and on a wet day the drivers slip badly and dig deep holes in the road.

The engineer rides in front and steers as well as runs the engine, the fireman being at the rear of the boiler.

These machines are built in San Francisco, by the Western Manufacturing Co., and are used quite extensively in the California mountains.

Road Locomotive, Truckee, Cal.

Big Speed Record of a Ten-Wheel Locomotive.

We have received several letters asking why it was that a ten-wheel engine with three pairs of coupled driving wheels, 68 inches diameter, made a much better speed record on the special fast train run over the Lake Shore & Michigan Southern on October 24th than any of the four-wheel connected engines, which had driving wheels 4 inches greater diameter and are of the same general dimensions. We believe that the principal reason why the ten-wheel engine made better time than the others was that she steamed very freely. While the cylinder dimensions of the eight-wheel and ten-wheel engines are the same, the latter have larger boilers than the former. The heating surface of the ten-wheeler that made the fast record is 1,603 square feet, while the eight-wheelers have only 1,413 square feet of heating surface. This would be a decided advantage in a particularly fast run.

While that engine made an exceptionally high speed performance, we do not think that master mechanics generally will be drawn towards ten-wheelers for pulling exceptionally fast trains. That type has some advantage in starting with a heavy train, but the extra parts swinging round are a highly undesirable feature of a high-speed locomotive.

It may be that the particular ten-wheel engine under discussion had some advantage over the eight-wheel engines from having a smaller wheel. If the train resistance was sufficient to balance the tractive force of the eight-wheel engines at, say, 65 miles an hour, the engine with the smaller wheel would have a little more margin of power, provided the boiler was capable of supplying the extra drain of steam called for by the increased number of revolutions that had to be made. Figured by the well-known formula for finding the tractive force of a locomotive, with a mean effective cylinder pressure of 50 pounds, which is high when the velocity is about 300 revolutions per minute, the ten-wheel engine would exert a tractive force at the rail of 5,000 pounds, while the engines with drivers 72 inches in diameter would exert a tractive force of 4,817 pounds. This difference is not great, being only about 4 per cent. in favor of the smaller wheel, but it would help some. The advantage is not enough to induce designers of high-speed locomotives to turn their eyes backward toward smaller driving wheels.

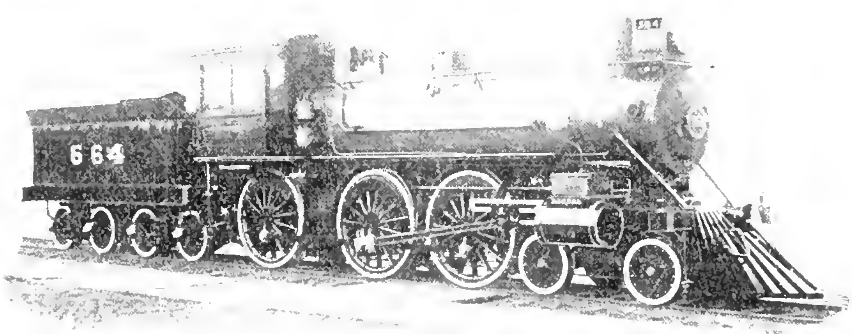
A prominent railroad official once said that his men always learned enough on a visit to a neighboring shop to pay for ten times the time it took. It's a poor mechanic who can't find a pointer in almost any shop. If this is true, the Erie ought to benefit from it. Superintendent of Motive Power Mitchell insists on his men mixing with their fellows. He has himself just returned from a visit to the Union Pacific shops as far West as Denver, while his assistant (Mr. Lavery) at Cleveland has just returned from a trip to California.

Making fast time on some special occasion is all easy enough, with the road cleared for you; but doing it every day for weeks is a different thing. During the summer just passed the Empire State express—time, $52\frac{1}{2}$ miles per hour for 440 miles—was on time everywhere for ninety consecutive days; then a train on a cross-over held her for a few minutes, and she ran thirty days again without a delay. That's business.

One Way of Making a Speed Record.

A few weeks ago the local newspapers were full of a tremendously fast run made by the Delaware, Lackawanna & Western, which seemed to eclipse anything done by the New York Central or Pennsylvania.

When Mr. Ely, chief of motive power of the Pennsylvania, wrote to General Manager Hallstead, asking for particulars of the dimensions of the engine and other facts which would throw light on the unusual performance, it is said that Mr. Hallstead wrote back: "This railroad company does not pride themselves on high-speed performances; we do not have a straight, level track, and we do not have four tracks to keep passenger trains away from freight; we do not have any '999' locomotives, and we do not have any 7-foot driving wheels; but we have some of the most accomplished liars east of Chicago, who have supplied the motive power on which the fast run was made."



A Record-Breaking Ten-Wheeler.

Railroad business is good on almost all trunk lines. Better times, better pay.

A Good Way to Circulate Current Engineering Literature.

The technical press is becoming so valuable and the mechanic finds so many useful hints and practices in the columns of the various papers, that he can ill afford to pass them by if he makes any pretensions to be up to date in his profession, and yet very few men engaged in mechanical pursuits have access to a large number of these periodicals.

C. S. Price, general manager of the Cambria Iron Company, recognizing this fact, has adopted a very good plan for the circulation of the large number of technical papers which come to the general office.

Each month the number is divided into two parts, and circulation started from the opposite extremes of the works. Each man is required to read within a specified time and pass on to the next in line. The annexed printed forms will explain the method. At the end of the allotted period, when all the papers are returned to the general manager's office, the signatures of the different persons who have perused the papers are attached; then the papers are filed away for future reference, and are accessible to anyone who wishes to peruse them further.

In order to permit as many as possible to look over such current periodicals, as soon as possible after publication, as are received by the Company, you will kindly see that this Journal is forwarded from your office within two days of its receipt, as directed below:

Forwarded by	Forwarded to	Date.	Signature.	Date Received.
General Manager.	Chief Engineer			
Chief Engineer.	Supt. Blast Furnaces.			
Supt. Blast Furnaces	Supt. Rolling Mill			
Supt. Rolling Mill	Supt. Steel Works. Arrange time mutually.		Bess. O. H.	
Supt. Steel Works	Supt. Order Dept.			
Supt. Order Dept.	Supt. Axle Dept.			
Supt. Axle Dept.	Supt. G. S. Mill			
Supt. G. S. Mill	General Manager.			

It will be filed in General Manager's Office when returned, and can be referred to at any time desired.

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Supt. Steel Works	Supt. Rolling Mill			
Supt. Rolling Mill	Supt. Blast Furnaces.			
Supt. Blast Furnaces.	Chief Engineer			
Chief Engineer.	General Manager.			

It will be filed in General Manager's Office when returned, and can be referred to at any time desired.

Inconvenience of Metric Measure in Shops.

The teachers in many of our schools and colleges continue to teach that the metric system of measurement is the only scientific system of metrology, and that it will eventually become the standard system of measurement for the whole world. They also keep saying that the length of the meter is based on the circumference of the earth, which is an error long exploded. People who express themselves in that strain do not appreciate the immense difficulty there would be in making the change. The United States and Great Britain are the two greatest manufacturing countries in the world, and all articles made to exact sizes are based on inch measurement. All screws and gages are based on the inch. To attempt a change on a large scale would cause endless confusion. There is really no need for the change except to satisfy sentiment, for those who have tried both systems say that ours is the most convenient for manufacturers. Speaking on this subject, Dr. Coleman Sellers said: "Over thirty years ago, I so far advocated the introduction of the metric system into the machine shop as to help its introduction entirely into one large department of the works (the injector department of William Sellers & Co.). I thus became familiar with the system, so far as to feel that it was part of my unconscious mental action; but its faults were shown so strongly in contrast with the inch series, that I came to be an active opponent to its forced introduction where it was not convenient in use.

When you are tempted to consider the so-called advantages of a decimal system of linear measure, think well before you commit yourself against the customs that obtain with English-speaking nations, holding to that which is the most convenient and useful."

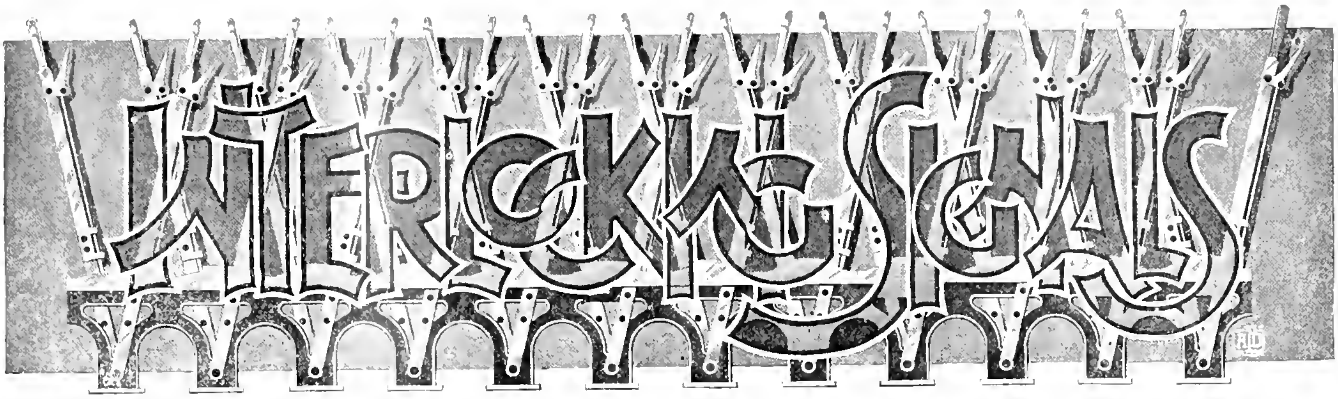
Our metrology lends itself to a good shop system better than does the metric system in use in France and Germany. We say, for instance, that the shop sizes in use are $\frac{1}{16}$ up to 1 inch, or to $1\frac{1}{2}$ inch, and to 3 inches by $\frac{1}{8}$ inch, then from 3 to 4 by $\frac{1}{4}$ inch, and by $\frac{1}{2}$ inch above that size. Such a system of shop sizes is easily kept in the memory, which is not the case when the millimeter is the unit of measure, when the shop series advance not by one or by two millimeters, but by one, two or three in alternation, as they agree with the sizes nearest to our inch series. This has to be done because the Whitworth system of screw threads, based on the inch and its subdivisions, is in use outside of the United States, and merchant iron is rolled to the inch metrology.

A Southern correspondent, who expresses the belief that some editors would pass a very poor examination on air brakes, incloses us the following paragraph, taken from a Southern paper:

"'He died with his hand on the air-brake pump and saved the train and passengers.' Thus it was said of Engineer John Patterson, who lost his life in the railroad accident Saturday night in Tennessee. His last thoughts were for the safety of the passengers on his train. Had he thought only of himself he might have saved his own life, with what results to others none can tell. Forgetting himself, thinking of the safety of others, he grasped the air-brake pump and met death instantly."

The Dickson Mfg. Co., of Scranton, Pa., have lately lost an old employé, who was highly valued and respected by the officers of the company. He was Alexander Turnbull, a Scotchman, who came to this country in 1852, and had been almost forty years in the employment of the Dickson people. He held the position of engineer. When they talked of retiring him on a pension, he always insisted that he would like to die "in harness." This came literally true, for one morning last month he died while sitting on his chair in the engine room. He had no illness previously, and seemed as if he had just gone to sleep.

The secretary of the American Railway Master Mechanics' Association has been laboring since last convention to induce railroad companies to adopt for shop use the decimal gage for sheet metal tubes, made standard at Alexandria Bay meeting. Over one hundred gages have been ordered, and the indications are that the Pratt & Whitney Co. will soon put the gage upon the market.

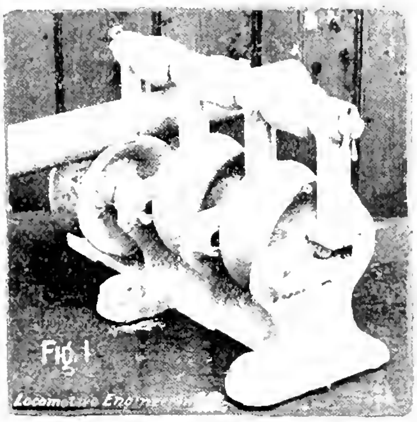


By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

Details of Construction.

[TWELFTH PAPER.]

There are many points regarding the form and particular arrangement of the several parts used in working the switches and signals at an interlocking plant, all of which are of great interest to signal engineers, or to those whose duties require them to keep such parts in repair, but to the average railroad man, who perhaps will never have occasion to use any knowledge that he may have gained relative to the "details of construction," a discussion

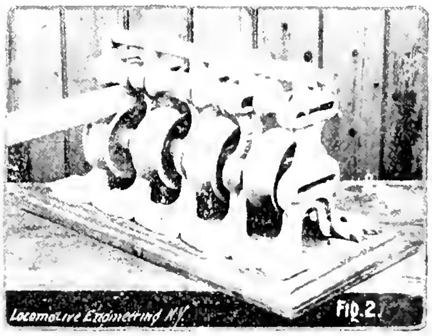


Anti-Friction Pipe Carrier.

of these questions cannot be expected to be so interesting or as useful.

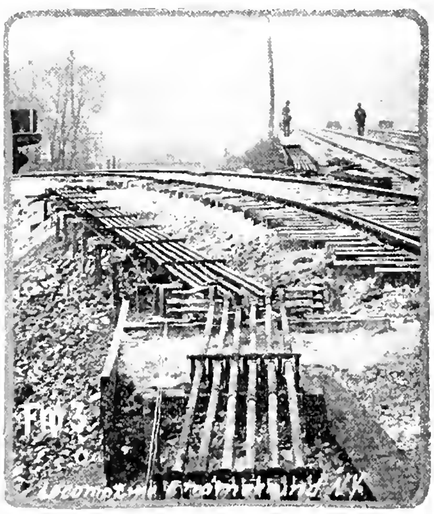
With those, however, who are daily required to read and act upon the indications of the signals, a knowledge of the construction will help them to put greater faith in the indications and to better understand the precautions taken to insure that a signal will not give a wrong indication.

The construction of the different machines and the method of moving and locking a switch having been explained in a previous article, the parts next to be considered are those used in making the connections, or the means whereby the motion of the levers is transmitted to the switches and signals. Those for the switches and locks are made of 1-inch iron pipe, while for connections to the signals they are generally made of No. 9 galvanized steel wire. Pipe is used, as giving for its weight and section the greatest stiffness, this quality being of the first importance from the fact that but a single connection is used between the lever and a switch, the power being applied as a pull



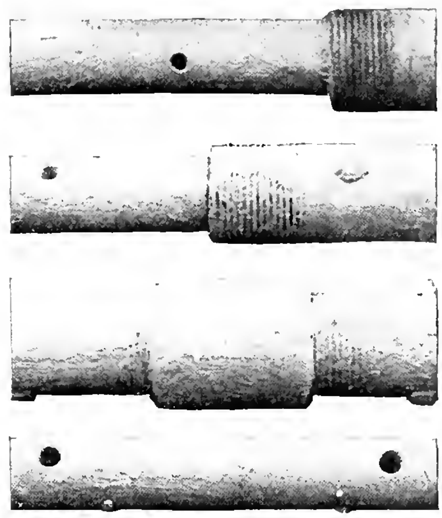
The Evans Double Anti-Friction Pipe Carrier.

for motion in one direction and a push in the other. If the pipe was used in tension only, but few supports would be needed, but to transmit any force by compression, it must be kept in a straight line, and to do this it must be firmly supported at short and regular intervals. These supports are called "pipe carriers," and are made of several different patterns, those of the anti-friction type being the best and



the ones now used in all new work. They are made as may be seen in Fig. 1, so as to allow the wheel which carries the pipe to roll on a center pin in a slot cast in the frame, all friction being done away with when the pipe is moved, except that due to rolling, which is very small. There being no rubbing friction, no oil is required with this style of carrier, and it is possible to box them in, no covers being needed.

The tendency of the pipe being to bend in any direction when power is applied, a small roller is fixed in the top part of the frame of the carrier, to hold the pipe in the groove in the lower wheel. As the lower wheel has to carry the weight of the pipe, the bearing seldom comes against the upper



A Plugged Pipe Joint.

wheel, so that the latter is usually made in the form of a sleeve slipped over a bolt, which answers for a shaft upon which it may turn. With the Evans carrier (seen in Fig. 2), the bearings of this upper wheel are also made anti-frictional, a rod being slipped through the top part of the frame to tie the several parts together, which, in this pattern, have to be made in separate pieces, to allow the wheels to be put in their proper places. The carrier, for this reason, is somewhat more troublesome to put in, two lag screws being needed for each section of the frame, and it is also more troublesome to work with, owing to the difficulty of moving any of the wheels, as is so often desirable in repairing or putting in any new parts, while the advantages gained by using the anti-

friction roller on top seem to be very slight.

Pipe carriers are usually spaced 8 ft. apart and are fastened to foundations which are buried in the ground. On some roads this distance is reduced to 7 feet, but for ordinary straight work there does not seem to be any need of going to the extra expense involved in putting them closer together. For 500 feet of pipe line, the spring of the pipe under a load of two switch-and-lock movements will be nearly 1 inch, or for 9 inches travel at the lever there will be but 8 inches at the movement. This spring has to be provided for in putting in the work, by making one of the crank arms at the movement longer than the other, so that the $8\frac{3}{4}$ inches of travel required for the full stroke of the movement will be obtained. In running the pipe lines, they should always be made as straight as possible, and never curved if it can be avoided. Where this has to be done, owing to curves in the track, the carriers should be put closer together, to prevent the pipe from springing or bending when the load is put upon it.

In curving out to run around a side track, when the angle is not sharp enough to require the ordinary form of crank, radial or ordinary cranks should be used, as shown in Fig. 3, the pipe all being run in straight lines. In joining the several lengths of pipe to make a long line, they are screwed together with an ordinary screw coupling such as is furnished with the pipe, an iron plug about 4 inches long, having holes for rivets drilled in each end, being put inside and riveted to each pipe, as shown in Fig. 4. Riveting the pipe in this way takes a great deal of the strain from the threads, and will even hold the pipe together should the threads work loose. Jaws for making the connections to cranks or switch-and-lock movements are fastened to the pipe by an ordinary coupling, the threaded end being turned down to go inside the pipe and be riveted to it in the same manner as a plug. As this method is patented and controlled by one of the signal companies, other ways of accomplishing the same end are to be found in use, but none that are on the market at the present time can be said to be satisfactory, except to weld the pipe to the solid end of the jaw.

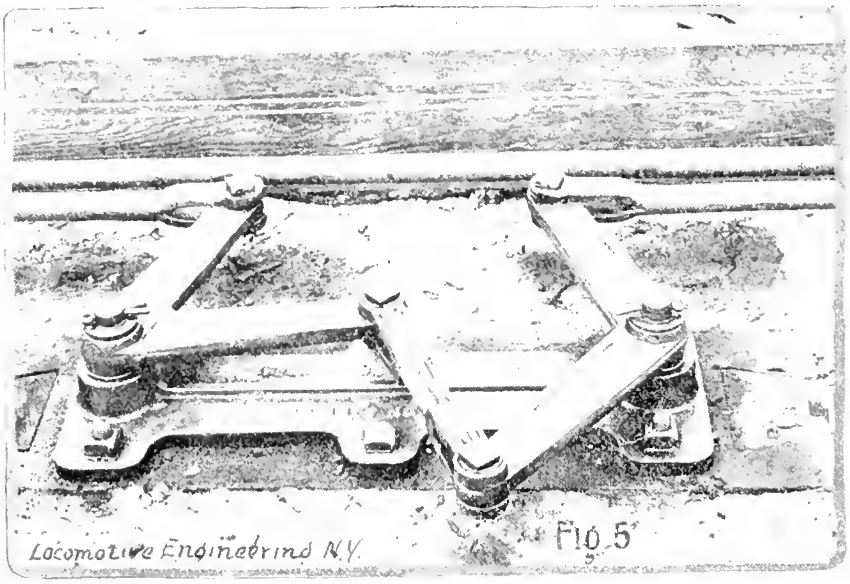
The connection between the lever and the switch being practically a solid connection, expansion and contraction have to be provided for to keep it of the same length, or else the movement might not be completed when the lever was reversed. The simplest way of doing this is to put a rocker in the middle of the pipe line, so that the motion or direction of travel in one half will be in the opposite direction from what it is in the other. When one half of the pipe line expanded with an increase in temperature, the other half would have expanded the same, the rocker being turned on its center to a new position, while the total length of the connection from the lever to the movement would not be changed.

Putting a rocker in the pipe line to reverse the motion is a very awkward and expensive arrangement, on account of the space required and the difficulty of running the pipe where there are more than two lines to be compensated.

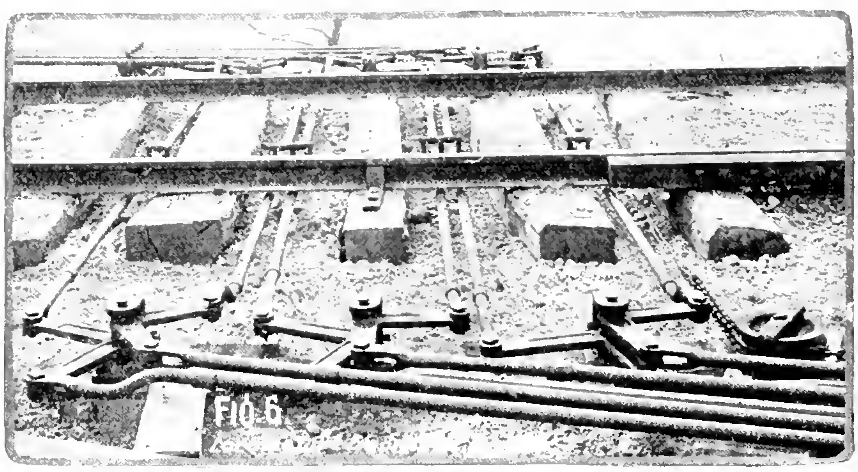
A device that accomplishes all that is required in this direction—and in a very neat way, too—is shown in Fig. 5, it being what is known as a "lazy jack" or compensator. As will be seen, it is made by arranging two cranks with a short connecting rod between them, on a base casting, one of the cranks being of a very obtuse angle and practically a rocker, and the other of a very acute angle, to change the direction of the thrust of the pipe line and make it as near a right angle as possible. In this way the pipe is continued in a straight line, while its motion is reversed and expansion and contraction provided for. But owing to the angles at which the two cranks are set with each other, the throw or travel of the pipe line is limited, the cranks, if turned too far, getting too near the dead center when it would not be possible to move them either way. For this reason one compensator is usually provided for every 500 feet of pipe, although distances of 700 feet are not uncommon. For distances less than 100 feet no compensator is needed.

Where the pipe line is under 500 feet in length, the compensator is put in the middle of this distance, or 250 feet from either end, and so, when two or more are used, they are each put in the middle of the length of pipe which they are to compensate. This appears simple enough, but workmen, unless watched, will divide the distance, spacing the compensators evenly between the levers and the movement, thus leaving a certain part of the line unprovided for. For example, if the distance to be compensated is 900 feet, the compensators should be put one-quarter of this distance, or 225 feet from each end, instead of 300 feet, as would seem at first sight to be the proper distance.

If it should be necessary to place two cranks quite close together in any pipe line, they may be connected up so as to reverse the motion, and thus take the place of a compensator. To arrange them in this way will be found very convenient in



A "Lazy Jack" Compensator.



running pipe lines around side tracks that have been put in after a plant is in operation, and when it is desired, on account of the connections to the switches, to keep them in the same relative position with reference to the track. This arrangement is clearly shown in Fig. 6, where the cranks are arranged to compensate and the lines outside of the side track are brought under and extend on parallel with the main line in the same numerical order.

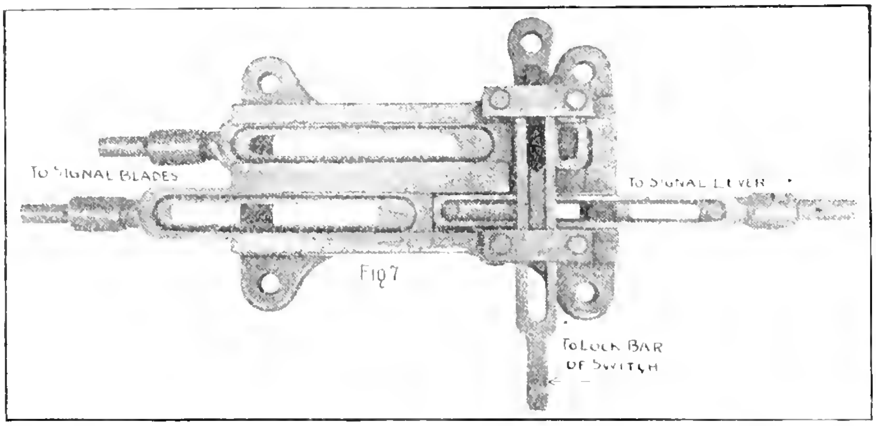
The foundations for the cranks, compensators and other parts of the apparatus subjected to very heavy strain are made of heavy oak lumber, dovetailed and braced, the whole being buried in the ground to the proper depth, tamped and finally concreted, this being made of one part cement to two of sand and three parts of crushed stone, such as will go through a 2-inch mesh. The concrete should be put in at least 12 inches deep, and for 12 inches around each side of the foundation. The cement used should be of the best quality, on account of the strains that are put upon the foundation, and while it is not necessary to go to the expense of getting the imported article, none but the best of domestic manufacture should be used.

At the present day the standard practice of connecting the home signal with the lever in the tower is to use two lines of wire, bolt locks, to prevent the signals being cleared unless the switch is closed, being connected to the down-pull wire, or the one that pulls the signal to clear. On several roads, however, a decided step in advance has been taken by making this connection of pipe instead of wire, thereby doing away with the necessity of constant adjustment, and the possibility of giving a wrong signal from this cause or from the breakage of a wire.

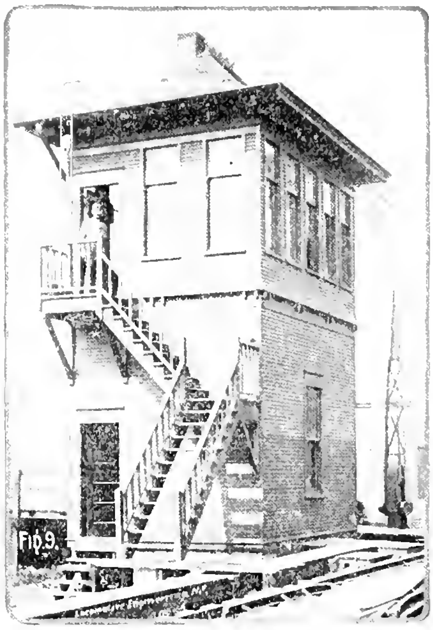
That the consequences would be serious were a wrong indication to be given by the home signal, no one will doubt, and while the cost of making the connection of pipe is considerably more than when two lines of wire are used, the additional safety secured in the operation of the plant most certainly warrants its use.

When the home signals are wire-connected, a bolt lock should be put in the connection to the distant signal as well as to the home signal. This is to make it impossible to clear the distant signal, as well as the home signal, unless the switch or derail has been properly closed, for if a bolt lock is not used, there is nothing to prevent the signals being cleared if the wire to the home signal should break between the bolt lock and the lever, the operator being then able to reverse the home-signal lever and pull over the lever of the distant signal. Should the wires to the home signal be caught, or should the derail not be closed and the bolt lock hold the wire, it is possible, from the spring in the wire, for an operator to reverse the home signal lever and then give a clear distant signal when the home signal had not been cleared.

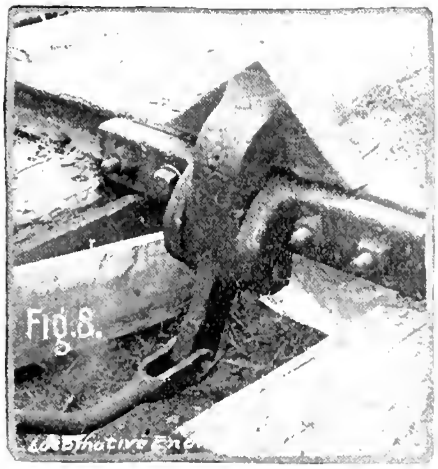
Connecting the home signal with pipe admits of the use of a strong and well-designed selector, and one that will act as



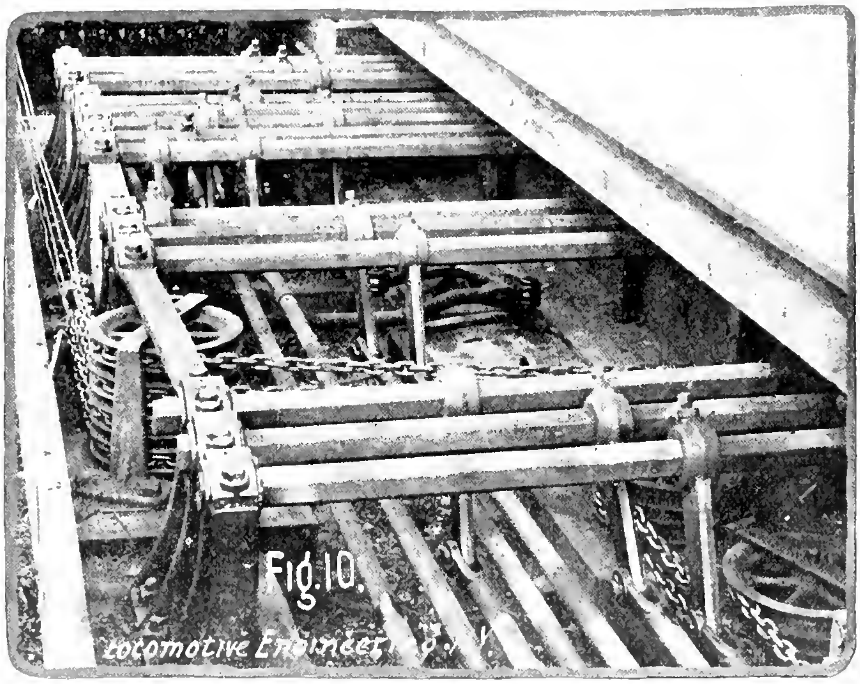
Selector for Pipe Connections.



C., M. & St. P. Tower.



A "Scotch" Block.



Rocker Shaft Lead-Out.

a bolt lock as well as a selector. This selector is shown in Fig. 7, and, as will be seen consists of two slide bars working in grooves in a cast base piece, and which are connected to the two signals to be operated, a third slide being provided which is connected to the signal lever, and so arranged by means of a crossbar that it may be made to slide in either of the grooves occupied by the other two bars, and, by shoving them out, clear the signals to which they are connected. The crossbar is usually connected to the lock bar of the switch, the operating slide being brought behind the slide which will clear the proper signal, to govern the switch the way it is set. Where not convenient to connect the selector directly to the lock bar of the switch, the crossbar may be worked by a motion plate operated by the pipe line working the switch, or else a direct connection, consisting of a crank and short connection, may be used When the crossbar is attached directly to the lock rod, the selector is made to act as a bolt lock, for, as the operating slide works in a notch cut in the crossbar when the slide has been pushed ahead to clear the signal, the crossbar will be locked, and with it the switch.

Where the connections are of wire there are several different forms of selectors that may be used, the design of each being made upon the same general plan. The connections being of wire, the signals must all be cleared by a pull instead of a push, each signal being connected to a long hook which can be caught by a sliding plate connected to the lever in the tower, and drawn back when the lever is reversed, instead of being pushed forward, as is the case with the pipe-connected selector.

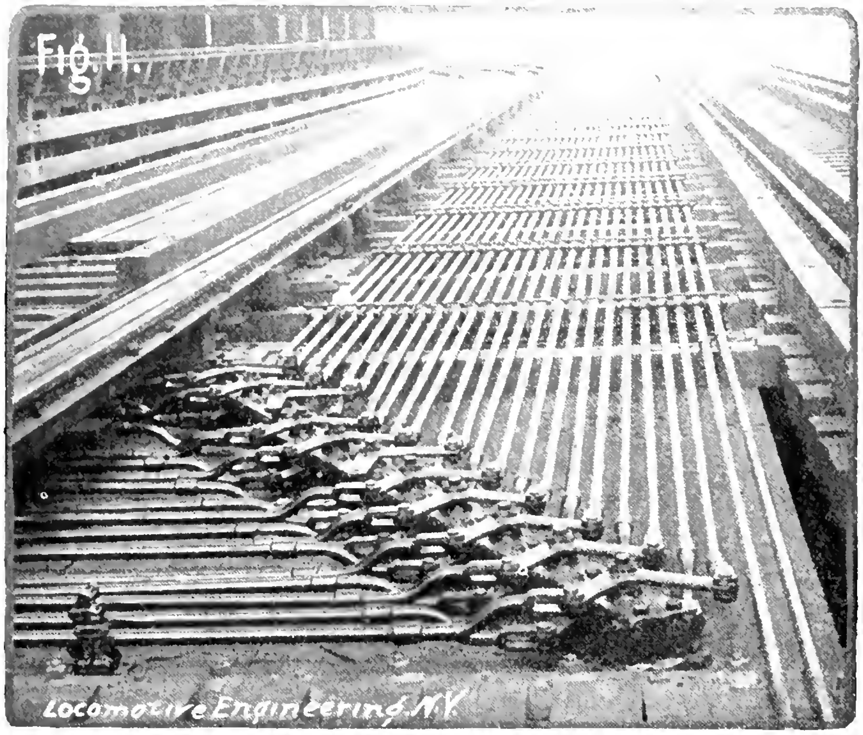
Differences in design are found in the several devices, whereby the movement of the pipe lines to operate the switch is automatically made to select the hook connected to the proper signal. Of these the one in most common use is where selection is made by means of a driving bar carrying dogs, which are set to throw every hook out of engagement with the sliding plate except the one to be operated, the driving bar being driven by means of a motion plate worked by the pipe line connected to the switch. Another way, and one that is more certain in its action, is to make the switch connection turn a shaft by means of an escapement crank, cam lugs on the shaft being provided to raise all but the proper hook to be operated.

With all of these forms of selectors, dependence is placed for their proper operation upon the assumption that the proper hook will drop and be caught by the sliding plate when the dogs or cams are set by the movement of the switch connection, and that the adjustment of the wire will be such as to bring the point of the hook in the proper position to be caught. As the adjustment of the hooks is often bad, owing to changes in the length of the wire —and they can easily be prevented, by snow, ice, dirt, or by a poor adjustment of the dogs on the driving bar, from being caught—it will be seen that the arrangement is not a very good one. To be relied upon, it should be positive in its action, and this can only be obtained by using pipe connections instead of wire.

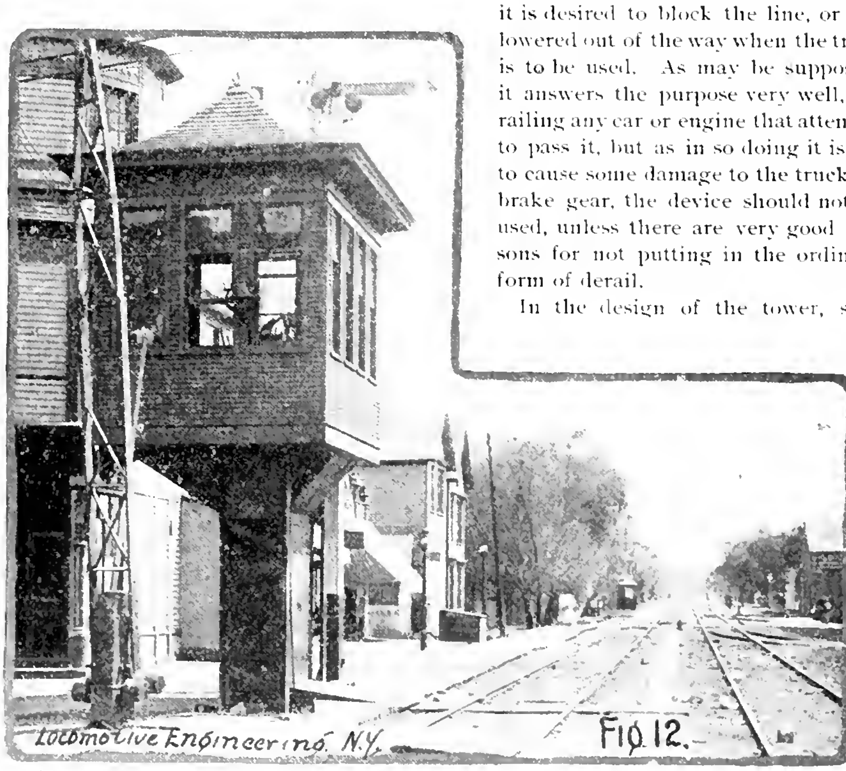
A device that is sometimes used in place of a derailing switch at short sidings, or where it is desirable to allow cars to stand as near the main line as safety will permit, is shown in Fig. 8, and is known as a "scotch block." It is connected to a lever in the machine, so that it can be raised on top of the rail in the position shown when it is desired to block the line, or else lowered out of the way when the track is to be used. As may be supposed, it answers the purpose very well, derailing any car or engine that attempts to pass it, but as in so doing it is apt to cause some damage to the trucks or brake gear, the device should not be used, unless there are very good reasons for not putting in the ordinary form of derail.

In the design of the tower, simplicity and cheapness, as well as adaptability for the purpose for which it is constructed, are the principal points to which attention may be called.

As will be seen in Fig. 9, the tower is



A Box Crank Lead-Out.



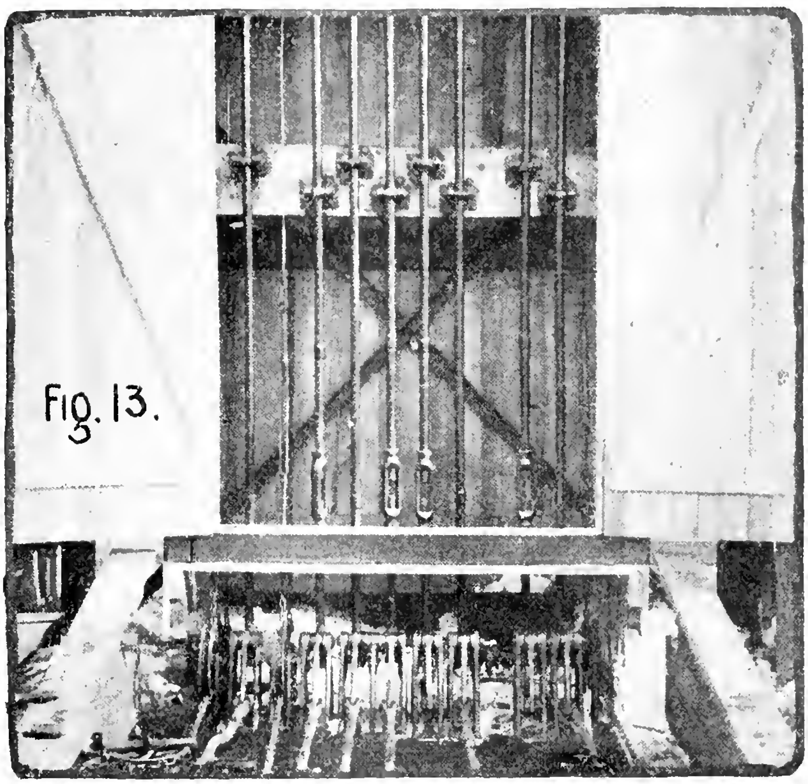
A Special Tower for Use in Cities.

made, two stories in height, to allow the operator to have an unobstructed view, as far as possible, of the tracks protected by the interlocking, the stairs to give access to the operating room being put on the outside of the building. A substantial frame work is put in, on which to place the machine, and heavy oak "lead-out" timbers are placed on top of the foundation on which to bolt the rocker shafts, or the cranks used to run the different connections out from the tower. The arrangement for this purpose which is the easiest to put in but the most expensive to use, is a rocker shaft lead-out as shown in Fig. 10. These should be made with the arms welded on instead of being fitted on a hexagonal shaft and fastened by a set screw, as is the case with the one shown, for the reason that the cranks are not accurately fitted as they should be and cannot be held tight by the set screw. As a little lost motion at the center is very much increased at the end of the crank, the travel of the pipe line being reduced by just that amount, it will be seen that this arrangement is not as good as when the arms are welded on, for, owing to the levers being interlocked, all lost motion in the connections is to be avoided.

By a judicious use of ordinary and box cranks, many lead-outs put in with rocker shafts could have been put in much more cheaply and yet with practically the same results. A box crank is shown in Fig. 11, and consists of an arrangement whereby any number of cranks are made to work on a single base, and make it possible to turn at a right angle, and in a very small space, a large number of pipe lines.

Towers should always be made somewhat larger than is necessary to hold the machine to be used, to allow for possible additions to the plant, the expense of so doing being very little in comparison with what it will cost to enlarge one already built.

One very prominent road builds its smallest towers large enough to take a 24-lever machine, thereby providing for the future and also giving ample room in which to get at all the parts. For towers that have to be located in places where there is but little room—between tracks, for instance—or where, as with the new electric street railway interlocking in cities, the tower has to be put upon the sidewalk, some form of iron framework has to be used, as shown in Fig. 12, the pipe connections being boxed in (Fig. 13) to prevent anyone except the proper persons from getting at or tampering with them.

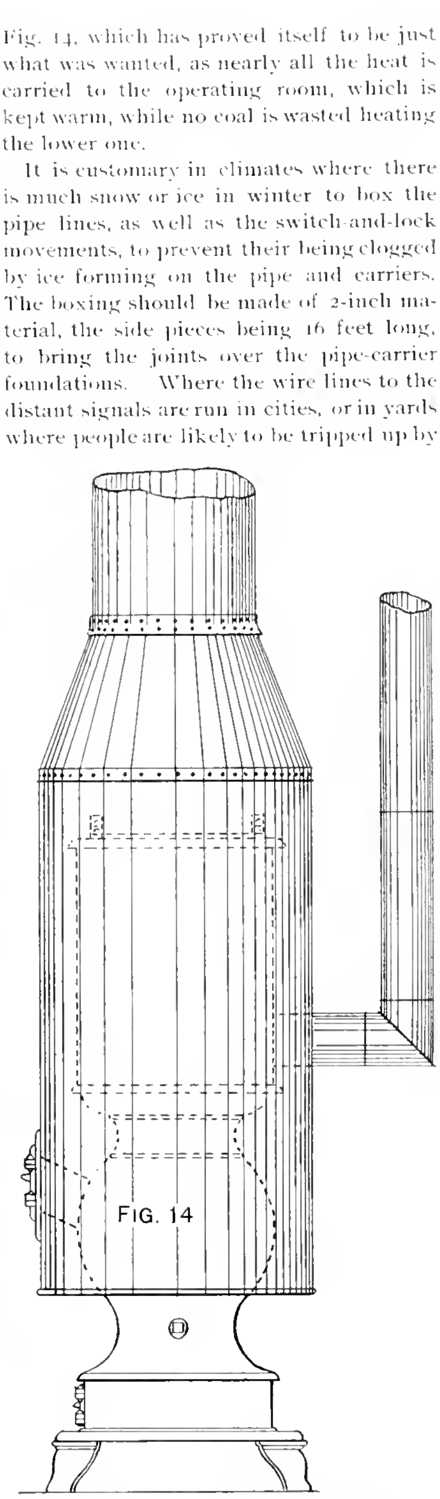


Lead-Out Connections for Special Tower.

The location of the tower is an important point and should be carefully considered before a decision regarding it is made. In a general way it may be said that it should be placed at some central point, where the best view of the tracks is to be had, this point being almost always on the outside of the curve, if the tracks are not run in a straight line. If there is but little choice in this respect, the tower should be located where the straightest, and therefore the simplest, connections can be made to the switches and signals.

Among recent additions and improvements to the tower may be mentioned a ladder, to allow of easy access to the roof in case of fire, as is shown in Fig. 9, and the casing surrounding the stove, shown in Fig. 14, which has proved itself to be just what was wanted, as nearly all the heat is carried to the operating room, which is kept warm, while no coal is wasted heating the lower one.

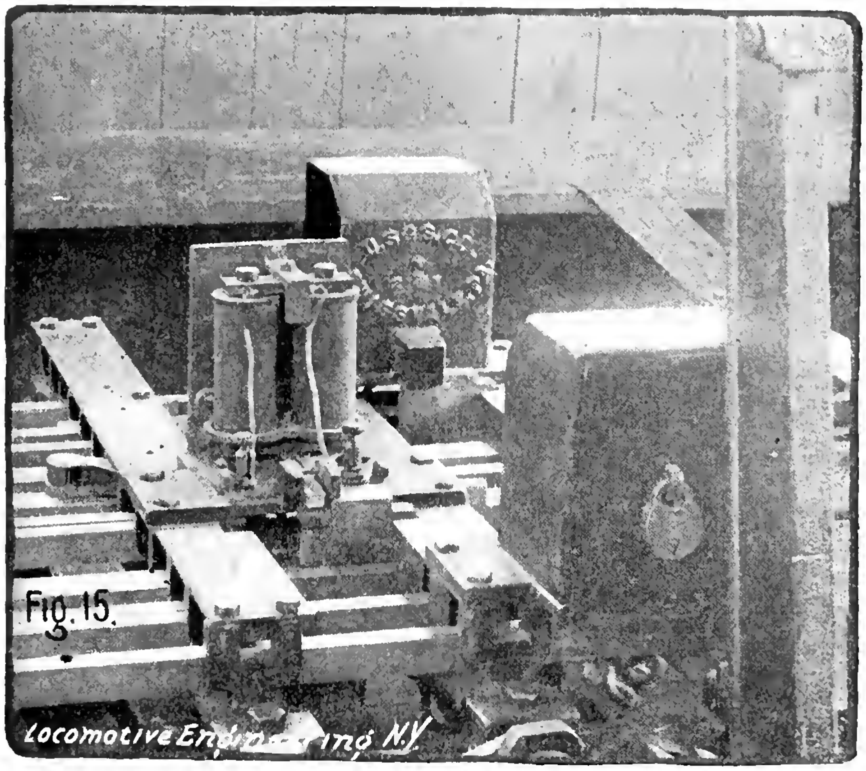
It is customary in climates where there is much snow or ice in winter to box the pipe lines, as well as the switch-and-lock movements, to prevent their being clogged by ice forming on the pipe and carriers. The boxing should be made of 2-inch material, the side pieces being 16 feet long, to bring the joints over the pipe-carrier foundations. Where the wire lines to the distant signals are run in cities, or in yards where people are likely to be tripped up by them, they also should be boxed. This boxing should also be made of 2-inch material, pieces 6 inches wide being used for the sides and 8 inches for the top. This is not the usual practice, 1-inch stuff being most generally used; but as the 2-inch will outlast the other almost double and will need but little attention or repairs, there can be no question but that it is true economy to use it.



Signal Tower Stove and Casing.

In the operation of an interlocking plant, a safety device known as "electric locking" of the levers is now being introduced more than ever before, as the advantages to be had by its use are becoming

more generally known. With it the levers of the machine are electrically locked, so that the operator, after once clearing the signal for a train to proceed, is unable to move the levers controlling the derails and switches until the train has cleared the limits of the interlocking. The lock itself is a very simple contrivance, consisting of an electro magnet, supported on a suitable frame and bolted to the locking brackets of the interlocking machine, as shown in Fig. 15, so that the armature when down will engage with a lug on the locking bar and prevent it from moving, and when raised by the attraction of the magnet will leave the bar free. A heavy casing is provided to inclose the magnet, so that when locked by the padlock provided for the purpose, the operator will be prevented from getting at the armature and releasing the lever before the train has cleared the interlocking.



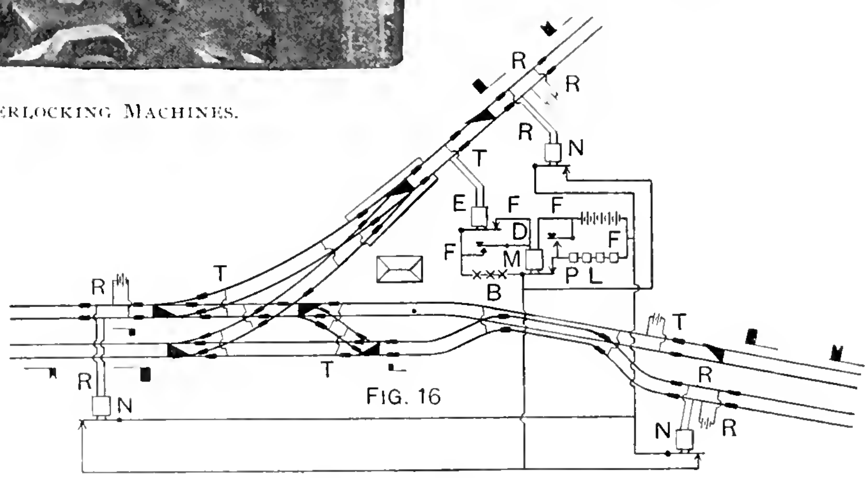
Electric Locks for Interlocking Machines.

To drop the locks and lock up the machine, a circuit breaker is attached to all the signal levers, so that whenever a signal is cleared, the circuit through the lock is broken, de-energizing the magnets and dropping the armatures. To prevent the circuit from being restored when the signal is returned to the normal position, which should be done by the time that the last car of a train has passed it, a track circuit is made use of to energize a relay, the armature of which, when down, breaks the circuit through the locks in the same manner as the circuit breaker on the signal lever.

The circuits made use of, and the manner of connecting them up, are shown in Fig. 16. *T* being the track circuit through the rails and energizing the magnet *E*, *F*, the locking circuit through the locks *L*, the circuit breakers *B*, the contact points *D* of the track relay *E*, the magnet *M* and the contact points *P* of that magnet; *R*, the releasing circuits energizing the magnets *N*, the armatures of which make a back contact when the magnets are de-energized, and complete the circuit *F* through the magnet *M* (but not through the locks), if the track-circuit relay is energized and the circuit breakers closed. The operation of these locks, and the effect on the circuits when a train passes through the interlocking, is as follows: The locks being normally held up, the switches are set and signals cleared for the train to proceed. Clearing any of the signals breaks the circuit *F* at the point *B*, dropping the locks and locking the derail lever reversed, so that it cannot be changed, at the same time dropping the armature of the magnet *M*, breaking the circuit at the point *P*, and preventing the locks from being raised when the signal is returned to the normal position. When the train passes on to the track circuit, it de-energizes the magnet, breaking the circuit *F* at the point *D*, so that the circuit cannot be restored and the locks lifted, if all the wheels of the train have not passed out of the interlocking. When the train reaches the releasing section, the magnet *N* is de-energized, the armature falling and completing the circuit *F* through the magnet *M* as soon as the circuit is restored at the point *D* and circuit breakers *N*. Energizing the magnet *M* raises the armature and completes the circuit through the point *P*, so that when the train passes off the releasing section, although the circuit *F* is broken at the contact point of the magnet *N*, it is maintained through the contact point *P*. The locks, however, are not raised until the circuit is broken at the magnet *N*, for although the circuit was completed through the locks and the point *P* when the magnet *M* was energized, it was also complete through the contact points of the magnet *N*, and as there is less resistance through these than through the locks, most of the current would flow that way, and the locks would not be raised until the contact at that point was broken.

If the signals have not been restored to danger before the train passes off the releasing section, the circuit *F* will not be completed through the magnet *M* and the machine will remain locked up.

An arrangement of circuits applicable to a simple crossing, in which the locking circuit is done away with, is shown in Fig. 17. With this arrangement the track circuit inside the derails is made the releasing section and no locking circuit is used, the action being the same as in the previous arrangement, with the magnet *E* left out. The cost of putting on this arrangement, complete, is not more than $150, and if proper care be used in the installation, it will cost but little to maintain and will seldom get out of order.



Electric Locking Circuits.

In case of accidents, or a failure of the circuits to release the locks, a switch is provided by which the operator can close and release the locks, by breaking a glass inserted in the cover of the box in which the switch is placed. Inclosing the switch in

this way is done to put a check upon the operator, to prevent him from throwing the locking out of service without good and sufficient reasons.

The circuits here shown are the simplest and best, I believe, for this purpose that have ever been designed, and have given most excellent results ever since they were put in service. They are much superior to the mechanical or interlocked relays that are used by the signal companies, as the action is positive, there being no trouble with sticking of the armatures, as with the latter, nor is it possible for the operator at any time to release the locks by jarring the relays.

The advantages to be derived from locking the levers in this way are: That the operator must return the signal to danger after the passage of every train, before it leaves the limit of the interlocking, thus compelling him to keep the signals at danger and not clear any one of them until on the approach of a train; that as long as any part of a train is within the interlocking, no change can be made in any of the switches that would lead to a collision or derailment—an advantage that is very great, considering the number of times that switches are run through by operators throwing the switch in front of a train, thinking that it has passed out of the interlocking; that having once cleared the signal for a train, it is impossible for the operator to open the derail or change switches so as to cause a derailment, although he is perfectly free to return the signal to danger at any time.

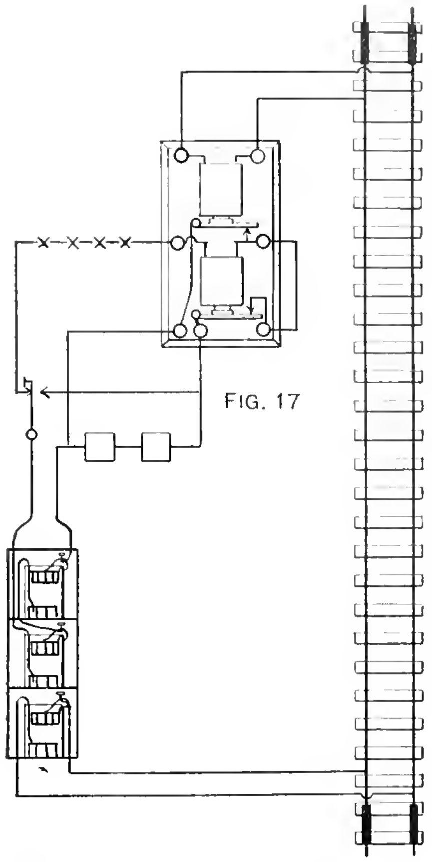


FIG. 17

ELECTRIC LOCKING CIRCUITS APPLICABLE TO A SIMPLE CROSSING.

That this latter is a very desirable feature, is shown by the large number of accidents that have happened by operators taking away the signals from one train and giving them to another, the train from which the signals were taken being derailed, owing to their having approached the crossing expecting to be allowed to proceed. One instance can be named where the operator cleared the signal for an approaching freight and then went to sleep. Hearing the whistle of a train on the other road, and forgetting that he had just cleared the signals for a freight, he changed the levers, opening the derails just in front of the engine. The engineer of the freight having observed the signal at clear, was approaching the crossing at a fair rate of speed, which, as the train was a heavy one, was sufficient to shove the engine and four cars completely over the crossing, entirely blocking it. Had the train for which the signals had been changed not been a passenger, and a light one at that, a collision would have happened, it having come to a stop within a car length only of the other train.

Then, again, with the electrical locking, there can be no question as to which train the signal has been given, and the claim so often made by engineers when they get into trouble, that the signals were taken away from them, will not hold with a plant so equipped. To those who fail to see the advantage of this and the great help that it gives in enforcing discipline, I would refer them to the superintendents who are able to send their engineers to plants so equipped, with the request that they come back and tell them if they were able to change the signals and switches, as they claim was done to them, and that if they could do so they would be given full pay for the time they were off.

Curious Wear of Driving-Wheel Tires.

A mechanical official of a railway in India sends us the following particulars of curious wear of driving wheels, and asks us to explain the cause of the phenomenon, if we can do so. We are not able to give any explanation, nor can several others, who are experts on the wear of driving wheels, give us any information. We therefore give the particulars to our readers, and shall gladly receive any facts or opinions that may be offered upon the subject. Our correspondent says: "Five engines of the same class were working in my district, all of the same make. They were six-wheeled goods coupled engines. The wheels are called leading, driving and trailing wheels. The driving wheels have the usual counterweight fixed between the spokes of the wheels. After these engines had been running about eighteen months, a peculiar groove formed in the center of the tire of the left-hand driving wheel of each of these engines. This groove did not extend right round the wheel, but it located itself immediately behind (opposite) the counterweight. It began where the counterweight began and ended where the counterweight ended. The groove was deepest immediately behind the center of the counterweight, gradually getting less and less as it extended outwards in either direction, ceasing altogether within the limits of the space occupied by the counterweight. Can you give any reason for such peculiar wear? Why should five of this particular class wear in this peculiar manner? Why should this peculiar groove confine itself to the left-hand driving wheel only? Why locate itself immediately behind the counterweight?"

The Sacred Oil.

"Did you hear about the hold-up on the West Michigan?" asked the "Central" man, as he scratched a match on the leg of his bloomers.

"No? Well, it shows where this economy business has got to. You know we've all been holding the boys right down to *drops* of oil—*pints* is an extravagant expression now.

"Well, train robbers hit one of the W. M. trains last month, and 'touched' the passengers, express car and crew.

"One of 'em climbed over the tank and poked the nozzle of a six-shooter under the engineer's ear and told him to hold up his hands—he did.

"'Now,' says the robber, 'I want yer valleybels; what ye got?'

"'Well,' said the engineer, 'I've got a month's pay in me clothes and a good gold watch and chain, and yer welcome to 'em—but, mister, for God's sake, *don't touch that valve oil!*'"

On two lakes but a few miles from Copenhagen a steamer capable of running on rails will be shortly seen disporting itself. The two lakes are separated by a strip of land traversed by a railway which crosses, in its course, a road, necessitating a gradient of 1 in 50 on either side. The rails are carried under water on a wooden structure, and the steamer, which carries two wheels fixed on either side so as to correspond with the rails, being guided by piles, makes for the rails at full speed, travels up the incline and down the other side, where the propeller again comes into action. The small wheels at the sides of the vessel are worked by a shaft and chain; a powerful brake is used in descending the slope.

A correspondent writes us from the general manager's office of the San Diego, Pacific Beach & La Jolla Railway that they are about to commence building a fifty-mile extension, which will make their road one of the most prosperous in the country when finished.

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Does Large Grate Area Promote Fuel Economy?

A remarkably interesting paper on "Wide Firebox Locomotive Boilers," by Mr. J. Snowden Bell, was read at a recent meeting of the Western Railway Club. The paper is particularly valuable historically, since it traces the gradual development of the large firebox as an element of the locomotive boiler, and presents many facts connected with this line of improvement which were not generally known. Besides tracing the development of the large firebox, the paper gives many interesting facts about novel forms of boilers tried, some of them having been very persistent in coming up periodically under slightly changed forms.

While contributing a very valuable chapter to the history of the locomotive engine, Mr. Bell takes occasion to advocate principles of designing which are by no means so acceptable as his history lesson. The following extract from a paper by the late John C. Hoadley is given near the opening of the paper:

"The weak point [of the American locomotive] was the narrow firebox and the limited grate area, necessitating rapid combustion, no less than 50, 80, 100 and occasionally 150 to 180 pounds of coal per hour on every square foot of grate; and to this admitted fact the American truss frame contributed in some small degree."

That extract is evidently cited as the gospel on which to preach a sermon on the advantages of large fireboxes. Like all other gospel, this text is accepted as being absolutely infallible, and no facts are considered necessary to prove the advantages that result from the use of a large firebox and the evils that flow from small grate areas. While the tendency of American designers of late has been to make the fireboxes of the forms that would give them larger grate area, we are by no means certain that unmixed gain results. Regarded from the standpoint of a marine or stationary engine boiler, the grate area of the ordinary locomotive is ridiculously small; but there are other features of a locomotive that do not compare favorably with stationary engine designs, and yet give remarkably economical performance in hard service. It has not been proven that making the grate area of a locomotive approximate that of a stationary engine furnace, intended for natural draft, will result in saving fuel *under average working*; and we believe that those who are making unusually large fireboxes are bringing into service locomotives that will be far from economical in the use of fuel.

There are circumstances under which the use of very large grates will be found advantageous. Refractory fuel, such as anthracite which burns slowly, slack coal which must be burned on a thin bed which air can penetrate, and inferior coal lacking in heat-generating properties, requires large grate areas; but the air-admitting surface which is found a benefit for these conditions will waste fuel when good coal is used, especially when the locomotive is working light.

The protest that has been uttered so often of late years against the waste of fuel resulting from burning a large quantity of coal per hour on a given grate area, is not based on the low evaporative efficiency of the fuel consumed so much as upon the dictum of the steam engineer, who gives a formula for the quantity of coal that can be most economically consumed per square foot of grate area. The formulæ given are mostly deduced from experiments with stationary and marine boilers. There have never been experiments carried out to demonstrate what amount of fuel can be most economically consumed per grate foot of a modern locomotive. Experiments made by D. K. Clark years ago would seem to indicate that the advocates of very large grates are reaching towards wasteful practice. The investigations which he made with so much care may not apply exactly to modern conditions, but they bear testimony which ought not to be ignored. An important deduction made from his experiments with locomotives was: "There may be too much grate area for economical combustion of fuel, but there cannot be too little so long as the required rate of combustion per square foot does not exceed the limits imposed by physical conditions." The "physical conditions" are providing means for admission of sufficient air to the fire to convert the fuel consumed into carbon dioxide, which gives the highest heat efficiency. When a greater volume of air is admitted to the fire than what is needed to convert the carbon into carbon dioxide and the hydrogen into water, the superfluous volume of that air causes waste of heat in various ways. In the first place, a superfluous volume of cold air has to be heated to the temperature of the gases of combustion, and this not only expends heat uselessly, but makes an increased velocity of the gases necessary. A high velocity means a shorter time in passing over the heat evaporating surfaces, and therefore less heat taken up. It means a lowered furnace temperature, which may cause secondary loss by portions of the firebox being too cool to burn the hydrocarbons released from the coal. These are highly valuable heat elements, but they require a very high temperature for combustion.

These reasons against the use of inordinately large grates are based on theory, just the same as the arguments in favor of them; but the results of practice seem to prove that the reasoning is sound. A locomotive is subjected to such varying conditions in service, that the grate is too small at one time and too large at another. If the engine is working very hard the large grate will be an advantage; when the work is light, fuel is wasted by excess of air supply. We have frequently known cases where engines were made to steam better and to burn less coal by putting in grates with restricted openings. It is a common experience to find that a light fire cannot be burned on a large grate and coal has to be heaped in to prevent excess of air supply. When either restricting the grate openings or heavy firing is necessary to make an engine steam freely, the grates are too large for the work the engine is doing.

In 1877 and 1878 papers were submitted to the Master Mechanics' Conventions, giving the results of a great many experiments made on a Chilian railroad, by Mr. John E. Martin, a highly-gifted mechanical engineer. Coal is very costly in Chili, and the experiments were carried out to find means of reducing fuel consumption as low as possible. He experimented with different methods of increasing and decreasing the grate openings, and reported that when burning first-class coal a saving of about 15 per cent. resulted from using a certain proportion of dead grate. When inferior coal was used, there was little benefit from the restricted admission of air. This would seem to show that a large grate surface is a help in the consumption of inferior fuel, but a source of waste with first-class coal.

The position which we take, that a very large grate area is not conducive to econ-

omy, has been found to be correct by the management of the Manhattan Elevated Railroad. In the development of their motive power, steady efforts were made to provide a grate area as large as possible consistent with the weight admissible. Increase of grate area did not seem to reduce the fuel consumption, and a trial was made of an engine with the length of grates reduced 6 inches. After the change the engine was much lighter on fuel than previously, and the officers of the company are now following the policy of keeping down the grate area to what they find to be the most economical limit.

There is no question that British locomotives are much more economical in the use of fuel than anything to be found in this country. The locomotives engaged pulling the racing trains between London and Aberdeen had grate areas that would be considered ridiculously small in this country, 20 square feet having been above the average. Yet the fuel consumed did not average more than 35 pounds per mile. Our fast trains have all been heavier than the British trains, but when the work performed is calculated on a ton-mile basis, the foreign locomotives do the service required with about 30 per cent. less fuel than ours. The same rule holds good through every kind of train service. The British locomotives are not deficient in grate area as reckoned by old rules for proportioning the grates in relation to the heating surface, but the tendency of our designers is to give a much higher proportion of grate. We cannot help thinking that there is a close relation between our excessive grate area and the large consumption of fuel.

We realize that we are a little out of the fashion in suggesting that the grate area of a locomotive may be made too large for the economical use of fuel. In these days of stationary plants for testing locomotives, it would be an easy matter to find out accurately the effect of changing the grate area. There are certainly reasons sufficient to justify any railroad company in making a thorough investigation of the subject.

Eight Years Old.

Locomotive Engineering completes her eighth year with this number. Since the first there has been no year passed without a substantial improvement in some way, and we believe 1895 has been as good as the best.

For 1896 the publishers have arranged to increase the number of reading pages to 600, and to give more and better matter than ever. Our engraving department has been strengthened, and the illustrations for next year will be better, and there will be more of them, more than any mechanical paper has ever published or attempted.

The editorial department has been reinforced with practical men just from railroad work, and we feel more than ever confident that we can give a big two dollars' worth to every reader.

It is our aim to make this paper instructive—show railroad officers and shop managers all the latest plans and devices for saving money—a sort of clearing house for the exchange of ideas, kinks and new devices. For engineers and firemen there will be more than ever attention paid to useful and instructive matter pertaining to locomotive running and firing. In this connection our air brake department, edited by the leading instructor in the country, F. M. Nellis, the man in charge of the Westinghouse instruction car, will be invaluable. Our aim is to aid these men to become better posted and more useful mechanics. We neither talk of nor teach anything on labor problems, social economy or fraternal organizations. We are only trying to raise the grade of locomotive engineering by helping the men in the ranks into knowing what is going on and the right and wrong of matters in their line,—mechanically.

The manager of one of the largest roads running out of Chicago, recently said: "No one can tell how much good this paper (Locomotive Engineering) is doing to the railroads of this country. It is interesting and educating the enginemen and shopmen as nothing else has ever done, and the marked improvement in engineering knowledge shown by these men, as brought out by the new plans of examination, is largely due to the efforts of its publishers." Praise enough.

Locomotive Engineering thanks its thousands of subscribers for standing by it in the past dull year; their support has enabled the management to carry out its plans and figure ahead for 1896. Times are better, the subscriptions *must* increase, advertising *must* follow the subscriptions, support and respect of an influential class of railroad men, and the future is sure.

The ninth year of Locomotive Engineering is going to be a red-headed success—watch it.

Over-Cylindered or Under-Boilered?

The expression so familiar to railroad men, "an over-cylindered locomotive," was repudiated lately in a paper presented to one of the railroad clubs, and the expression "boiler not large enough" recommended as stating the condition more correctly. With all due deference to the views of the gentleman who recommends this correction of expression, we prefer the old one, and consider that it is more correct than the new one. To understand the case properly, it is necessary to investigate the influences which made the over-cylindered locomotives of a decade or two ago so common.

Twenty years ago the average track was laid on a highly yielding foundation, and most of the bridges were not safe for heavy loads. These conditions naturally required that locomotives should be light. About that time freight charges were dwindling down, till operative officers found that the expenses of hauling trains must be reduced if the roads were to pay operating expenses. In looking around for means of cheapening the car mileage, they found with singular accord that more powerful locomotives was the first help over the difficulty. Operative officers in those days were in the habit of estimating the power of a locomotive by the size of the cylinders, and they had a great deal to say about what were the best designs of locomotives.

Under the influence of the operative department, cylinders began to be increased without regard to the size of the boilers. An agitation in favor of large cylinders arose, and we know that several locomotive builders proceeded to increase the cylinders without increasing the size of the boilers. In fact they were restrained so much on the total weight of the engine that they had sometimes to make the boiler of a 17x24-inch engine lighter than the boilers previously made for 16x24-inch engines. Within five years the country was flooded with over-cylindered engines, that made themselves conspicuous by inefficiency from slipping and by extravagant waste of fuel. When the tendency in this direction was at its height, we had a case where the 16x24-inch cylinders of an engine were smashed in a collision. When new cylinders were ordered the general officers insisted that they should be 19 inches diameter, and that size was put on.

The railway world is indebted to the Railway Master Mechanics' Association for a prolonged agitation in favor of sensible proportions of boilers and cylinders, which convinced the operative officers that an over-cylindered locomotive was an expensive mistake. The first remedy applied was not increasing the size of the boiler, but in bushing the cylinders. When the boilers got worn out larger ones were put on and the cylinder bushings taken out. These facts prove that the term "over-cylindered" is by no means a misnomer.

About midsummer, business appeared to be in a condition that promised a boom in nearly all departments of industry, especially in those industries with iron as the basis of prosperity. We have been very much surprised, however, within the last few weeks to find that instead of advancing business has become decidedly less active. In every manufacturing establishment we have visited within the last two weeks bitter complaints are heard of the unjustifiable rise in the price of iron that has taken place during the summer. Iron makers, particularly makers of steel, have pushed the product up to an unjustifiable price, and have deliberately arrested the return of prosperity, which seemed to be coming fast to the country. There appears to be no justification for this action. There has been little demand for steel

products within the last two weeks, but the prices have never gone below a profitable level. This is particularly the case on steel rails, on which there has been a good profit at the lowest price quoted. As soon as the prospects appeared for a demand for steel rails, the price was gradually raised until it was $5 or $6 a ton above what was admitted to be a profitable price during the dull times. The effect of it has been that railroad companies have determined to wait until the steel barons return to their senses. As far as we can see, this class of industrial magnates are the worst tyrants that the country has ever seen. The price of iron is now going back, and steel rails will have to follow, but it seems certain that the grasping spirit displayed by leaders in this line of manufacture will set back the return of prosperity to this country at least one year.

BOOK REVIEWS.

A Library of Steam Engineering. By John Fehrenbatch, M. E., Ohio Valley Company, Cincinnati. Price, $5.

We have not been able to read the 800 pages, 9½ x 6 inches, which make up this book, but, from a very prolonged and careful examination of the various articles, we are inclined to believe that it deserves the title given to it better than anything ever previously published. It appears to cover the whole field of steam engineering and a great many other departments besides. We think that "A Library of Mechanical Engineering" would be a rather better name for it, because we have not been able to find any line of mechanical engineering which is missing.

The volume has been the life work of a mechanical engineer of wide experience. He was for a time president of the International Association of Mechanical Enneers, was president also of the National Association of Stationary Engineers, and was for thirteen years United States Supervisor Inspector of Steam Boilers. The honorable positions which he held in the engineering world are sufficient guarantee that he is a mechanical engineer competent to write authoritatively on subjects relating to his profession. The book is prepared from notes taken during a lifetime. The facts have been worked up in a most interesting form, and the various engineering formulæ are presented so that they can be worked out by arithmetic. To a man who is in the habit of using reference on engineering matters, this book will be of the very greatest value. For ourselves, we feel satisfied that it will take the place of a dozen books now used for finding data to answer questions concerning mechanical engineering problems. The book is divided into twenty-seven chapters, among which we may mention Mathematics of Steam Engineering, Valves Generally, Steam Boilers, Riveted Joints, Calorimeter Tests, Speed of Pulleys and Gearings, Electricity, the Steam Engine Indicator, A United States Battleship, Slide-Valve Engines, Locomotives, and Steam Boiler Injectors. The varied subjects are not treated so exhaustively as we find in books specially devoted to each subject, but each chapter gives enough information on the subject treated to give a student a good, intelligent idea of the subject. The book is profusely illustrated with good engravings, and is got up in a style which is highly creditable to the publishers.

Tales of an Engineer, with Rhymes of the Rail. By Cy Warman. Charles Scribner's Sons, New York. Price, $1.25.

There are few readers of railroad engineering literature to whom the name of Cy Warman is not known, and known pleasantly, as he is one of the most charming writers in prose and verse that have taken the doings of the railroad world for their theme. Hitherto Mr. Warman's writings have been mostly in the effervescent form of newspaper articles that soon are overtaken by oblivion. Readers of current literature often regret that they cannot readily turn back to a charming article or a beautiful poem that was read months or years before, and we have no doubt but that many regrets of this kind have been experienced in connection with the sketches, poems and stories produced by Cy Warman. The people who have felt that way will be gratified to learn that Warman's writings have been collected in book form and published by the firm mentioned for the modest price of $1.25. The volume is got up in very artistic style, and will be an ornament to any parlor table or library.

The book is dedicated "To the Great Army of Enginemen; the Silent Heroes Who Stand Alone and Bore Holes in the Night at the Rate of a Mile a Minute." The author can well appreciate the position of railroad trainmen in these days of high train speed, for he went through the experience which one of his sketches describes under the heading, "From the Corn Field to the Cab." Cy was an engineman on the Denver & Rio Grande for several years, and many of his sketches are the reward of his keen observation in working the attractive features out of hard, prosaic facts. We earnestly commend "Tales of an Engineer" to every reader of Locomotive Engineering who likes to see the romantic side of railroad life presented in readable form. It is for sale in this office.

The Housing of the Working People. Prepared under the direction of Carroll D. Wright, Commissioner of Labor, by E. R. L. Gould, Ph.D. Published by Washington Government Printing Office.

This volume is the eighth special report of the Commissioner of Labor, and is devoted almost exclusively to the subject named. It contains 443 pages of reading matter, and is profusely illustrated with engravings of all kinds of residences that have been designed and built for workmen. The kind of dwellings used for all classes of workmen in the real industrial countries of Europe and America are described and illustrated. The book will constitute an inexhaustible mine of information for people interesting themselves in this line of social problems.

Modern Examinations of Steam Engineers. By W. H. Wakeman. American Industrial Publishing Co., Bridgeport, Conn. Price, $2.00.

This book is intended as a handbook for steam engineers, to enable them to pass the examinations required in different States before men are promoted to be in charge of steam boilers. It is very comprehensive, and is a very good treatise on steam engineering, put in exceedingly simple form that any man having a common school education can understand. It has been written by a man who has gone through a long course of acquiring knowledge of steam engineering by actual experience. He gives the result of his experience to others in a form that they will never have any difficulty in understanding. We are greatly mistaken if the work does not become highly popular with men in charge of steam plants. They will certainly be better engineers by making this book their daily companion. The book is likely to become our reading evidence of the fact that the "book engineer" is a man who acquires the knowledge of his business in the most direct form, and is a competent engineer long years before the purely practical man learns the elements of his business.

Link and Valve Motions. By Wm. S. Auchincloss. Thirteenth Edition, Revised. D. Van Nostrand Co., New York. Price, $2.00.

For the last 26 years "Auchincloss" has been the best authority among engineers concerning link and valve motions. We know of no single work on engineering which has maintained its popularity so long. This popularity has been due to the fact that the work never had any rival worthy of the name. We are glad to find that Mr. Auchincloss has revised this useful book and brought it up to date. The revising has consisted principally in the eliminating of abstruse formulæ found in previous editions, formulæ which were a dead letter to most practical engineers, who have not the time to work out solutions by the higher mathematics involved. The book is got out in as fine shape as it previously was, and in substantially the same form, yet the price has been reduced $1.00. It is needless for us to say that every man ambitious to understand link and valve motions properly, ought to make "Auchincloss" an intimate associate It is for sale in this office.

Transactions of the American Institute of Electrical Engineers. Published by the Institute, New York.

This is a large volume of close on one thousand pages, and consists principally of papers and discussions at the meetings of the Institute of Electrical Engineers during the last year. There is a great deal of valuable and interesting matter for electrical engineers in the report. All sorts of subjects connected with electrical engineering have been reported on and discussed. They are too numerous for us to go into details, but it is sufficient to say that the papers and discussions reflect the views of the most accomplished electrical engineers in the country.

The Baldwin people have chartered a whale-back steamer to carry twenty locomotives to Russia. The engines are about ready for shipment. This is part of the order of forty locomotives, which the Baldwin Works recently received from the Russian Government. All the engines are Vauclain four-cylinder compounds. Twenty of them are ten-wheelers and the others are consolidation engines, weighing about 120,000 pounds. The ten-wheelers have six-wheeled tenders. All the engines have copper fireboxes, iron tubes, cast-steel driving-wheel centers and cast-steel truck and tender-wheel centers, with steel tires. They are all equipped with appliances for burning petroleum, that fuel being used very successfully in Russia.

Color Finish for Passenger Equipment Without Varnish.

At the Aurora shops of the Burlington road can be seen some experimental color boards, outside of the paint shop, that are interesting.

They have been exposed to the weather for about four years and go to show that varnish is a bad thing for paint—and this is how it is proven:

A large board, representing a section of the side of a passenger car, was set up and treated as follows:

The whole board was given a coat of priming; a strip about a foot wide on one end was then left and the rest of the board given a coat of filling; another strip was left and the second coat of filling given to the rest of the board; then came two coats of color and three of varnish, each time leaving a strip, so that the final strip on the board was the only one completely finished, just as they finished a passenger coach.

It is interesting to note that the last strip on this board, after many months' exposure, is the worst-looking of the lot; it is practically bare down to the wood; the next is little better, and so on until about the second color coat, which is still in the best preservation.

There are other boards here testing colors, varnish and roofing material, but this is the interesting one.

About two years ago Mr. Rhodes, the superintendent of motive power and machinery, decided that these experiments justified him in making an attempt to reduce the cost of painting and varnishing passenger equipment—a very costly item. Having had satisfactory experience with Rogers' locomotive finish, a varnish paint, he decided to try similar material on coaches. The Detroit White Lead Works soon matched the standard color—yellow—with a paint similar to the engine finish, and coaches were taken in, burned off, and treated to one coat of priming, one of filling and two of the color finish—thus reducing the operations by half. Striping was reduced from about $16 to $6 worth, and the trucks painted with mineral, a brown color, without striping of any kind. After a trip in the dust they look just as good as any trucks.

The interior of the coaches are simply varnished, not rubbed down or finished.

The outside of the cars looks as well fifty feet away as those with twice the work on them, the color stands splendid, and a great saving in cost has been made.

For anything that has to stand the weather, as a passenger coach has, it is doubtful if it pays to finish to excess; the cheaper finish can be given oftener and the general appearance kept bright and good.

Of course, a painter can tell one of these cars a long way off, and it "don't look right" to his trained eye, but the nine hundred and ninety-nine passengers can't tell the difference.

No varnish is used either on the locomotives or coaches of this company.

Few people have ever thought what the effect of varnish is on paint, unless they thought—without knowing just why—that the varnish protected the paint. That the contrary is true seems to be proven by these experiments.

This color finish is composed largely of oil or varnish and the proportion of color is slight. The foreman painter opened a can for our inspection, and the top was clear as varnish, the coloring matter being at the bottom and not over one-eighth of the whole in volume.

Saving half the expense of painting passenger equipment and getting it back into service quickly means a great deal of money in a year's expense to a big road.

PERSONAL.

Mr. Collis Shanks has resigned his position of general foreman of the S. C. shops at Los Angeles, Cal.

Mr. J. H. McKee, of the firm of McKee, Fuller & Co., car builders at Catasauqua, Pa., died in Philadelphia, aged 78 years.

Mr. G. A. Miller, who has been acting master mechanic of the Florida East Coast Railway, has been appointed to the position.

Mr. George P. Johnson, of Frederick, Md., is appointed superintendent of car service on the Seaboard Air Line at Portsmouth, Va.

Mr. G. W. Prescott, superintendent of the machinery and car departments of the Southern California Railway, of the Santa Fé system, has resigned.

Mr. C. G. Lundholm has been appointed general foreman of the S. C. shops at San Bernardino, Cal., in place of T. D. Williams, transferred to Los Angeles.

Mr. H. M. Missimer has resigned the office of master mechanic of the Lehigh & Hudson River Railway, and is succeeded by Mr. F. W. Mast, at Warwick, N. Y.

Mr. T. R. Brown, assistant master mechanic of the Pennsylvania shops at Juniata, succeeds Master Mechanic H. D. Gordon, whose resignation we chronicled in our last issue.

Mr. F. B. Smith, formerly master mechanic of the New York, Pennsylvania & Ohio Railway at Meadville, Pa., has been appointed general master mechanic of the New York, New Haven & Hartford road.

Mr. W. R. Setchel, at one time connected with the New York, Lake Erie & Western Railway, at Hornellsville, N. Y., is appointed assistant master mechanic of the Wheeling & Lake Erie road at Massillon, O.

Mr. John Higginson, the master car builder of the Canadian Pacific Railway, resigned that position on November 1. Mr. George A. Eaton, foreman of the Hochelaga shops, will fill the position for the present.

Mr. W. P. Appleyard has received the appointment of master car builder of the New York, New Haven & Hartford Railway, reporting to Mr. John Henney, Jr., superintendent of motive power at New Haven, Conn.

Mr. R. H. Relf, chief clerk to the chief engineer of the Northern Pacific Railroad, and one of the old-timers of the engineering department on the road, has been appointed secretary to the receivers controlling the Eastern district of that road.

Mr. E. Humphreys has been appointed supervisor of engines and trains for the Cincinnati, Washington & Louisville division of the B. & O. S. W. Ry. Mr. R. H. Wallace has been appointed to a similar position on the St. Louis & Springfield division.

Mr. Geo. Hesnan, for several years foreman of the car department of the C., R. I. & P. R.R. at Kansas City, has been appointed general car inspector at Grand Junction, Colo. Mr. Hesnan is one of the best informed car men in the West, and has been remarkably successful in his line.

Bryan & McKibbin, of 120 Broadway, New York, have been appointed general agents for the Cooke Locomotive & Machine Co., of Paterson, N. J. This is a very good connection for the new firm of supply men to make, and we feel sure that it will be highly satisfactory to both interests.

Mr. Albert Griggs, assistant superintendent of motive power of the Chicago & Eastern Illinois R.R., has resigned and the position has been abolished. Mr. Griggs has returned to his old home in Rosendale, Mass., and can be reached there by any railroad interest wishing to secure his services.

Mr. Henry G. Ashton, the inventor of the Ashton safety valve, died of apoplexy at his home in Somerville, Mass., on the 12th of November. His inventions of safety appliances for boilers were of wide utility, among which were the Ashton pop valve, the Ashton blow-back valve and many other lesser but equally important devices.

Mr. C. F. Lape has been appointed superintendent of the machinery and car department of the Southern California, in place of G. W. Prescott, resigned. Mr. Lape was connected with the Wabash as master mechanic for a number of years, resigning later to accept the position of State Railroad and Warehouse Commissioner of Illinois.

Mr. F. N. Hibbetts, formerly master mechanic of the Rochester division of the New York, Lake Erie & Western Railway at Rochester, N. Y., has been appointed trainmaster of the Eastern division, succeeding Mr. George H. Dowe, who has been promoted to the superintendency of the Jefferson division of that road, with headquarters at Carbondale, Pa.

Mr. J. K. Lane has resigned the office of

uperintendent of motive power of the Louisville, Evansville & St. Louis Railway, and the position has been abolished. Mr. J. F. Sechler has been appointed master mechanic to succeed Mr. Lane in the duties of the abolished office. Mr. W. E. Looney has received the appointment of master car builder of the same road.

Mr. F. G. Prest, who has been assistant general purchasing agent of the Northern Pacific Railway for several years, has received the appointment of purchasing agent for the receivers of the Eastern jurisdiction, which takes in the lines from St. Paul and Ashland, including all branches, to the Montana line. The office of general purchasing agent is abolished, owing to the division of the road into two districts.

Mr. W. E. Symons, master mechanic of the A., T. & S. F., at Raton, N. M., resigned on the 15th of November. Mr. Symons will recruit his health for a few weeks and then seek an opening in a more desirable location. The power of the mountain division of the Santa Fé road has never been so well handled as it has under Mr. Symons, who has had charge there for the past four years; he is not only a first-class mechanic, but possesses the other great requisite, the ability to handle men.

EQUIPMENT NOTES.

The Atlantic & Pacific are about to have 2,000 freight cars built.

The Carlisle Manufacturing Company have a contract for 200 freight cars.

The Rock Island have just received 100 new coal cars from the Wells-French Co.

The Toronto, Hamilton & Buffalo are in need of several passenger coaches at once.

The Toronto, Hamilton & Buffalo is in the market for some new passenger equipment.

The B. & O. earned the enormous sum of $22,817,182 for the fiscal year ending June 30, 1895.

The Pittsburgh & Lake Erie are having ten ten-wheelers built at the Pittsburgh Locomotive Works.

At the Altoona shops of the Pennsylvania road, work has been started on five Class R freight engines.

The Gulf & Interstate road of Texas is having two engines built at the Rhode Island Locomotive Works.

There are well-founded rumors that the Chattanooga Southern are about to buy 100 cars and one locomotive.

The New York, Chicago & St. Louis Railway is reported to need at once a number of box and coal cars.

The Lenoir Car Company, of Lenoir City, Tenn., will build 100 coal cars for the Tennessee Coal & Iron Company.

The Haskell & Barker Company, of Michigan City, Ind., have an order from the Illinois Central for 1,000 freight cars.

The car building companies on the line of the Pennsylvania road are in receipt of orders from that company for 1,000 coal cars.

The Westinghouse and American Brake Companies are running full-handed, furnishing brakes largely for old engines and cars.

The Chicago & Great Western require eight to ten passenger coaches, the order for which will be in somebody's hands soon.

The Bangor & Aroostook road is having two heavy engines, with 70-inch drivers, built at the Manchester Locomotive Works.

The firm of Black, Sheridan & Wilson have ordered fifty coal cars of the South Baltimore Car Works for use on the Baltimore & Ohio.

The Brooks Locomotive Works, of Dunkirk, N. Y., have an order from the Ohio River road for two freight engines, to be delivered as early as possible.

The Norfolk & Western Railway is ordering about 100 cars in small installments. A large order is also in sight on this road for quick delivery.

The Central of New Jersey has given an order for 500 cars, to be equally distributed between the Lehigh Valley Car Company and the Murray-Dougall Company.

The Midland Terminal Company of Colorado will soon have their own equipment in operation on their line. They now lease their rolling stock from other lines.

The Great Northern earned $13,100,930 during the year ending June 30th; $10,365,031 of this was from freights. This is nearly $2,000,000 more than last year.

The Holden device for burning liquid fuel is being applied to a locomotive on the Pennsylvania road. A demonstration of what there is in it will be made at once.

The Chesapeake & Ohio road has placed an order with the Ensign Car & Manufacturing Co. for 100 plain, thirty-four-foot gondolas of 60,000 pounds' capacity.

The Billmeyer & Small Company is busy on an order for 100 new freight cars for the Pennsylvania, and also a large number from Western and Southern roads.

The Brooks Locomotive Works have begun their delivery to the Lake Shore & Michigan Southern Railway of the first instalment of ten freight locomotives on the July order for thirty-five engines.

The Pittsburgh, Fort Wayne & Chicago has just completed a new Class R engine at the Fort Wayne shops. It is the seventh engine of this class turned out of these shops in about twelve months.

The increasing business of the Toledo, St. Louis & Kansas City road demands some new equipment, and Receiver R. B. F. Pierce has applied to the courts for authority to purchase 500 new coal cars at once.

The South Baltimore Car Works has received an order from Mr. W. J. Chapman for fifty gondola cars of 60,000 pounds' capacity, equipped with air and vertical plain couplers, for use on the Baltimore & Ohio Railway.

The order of the Pennsylvania road for 1,000 new cars is apportioned among the builders as follows: 400 to the Pullman Company, 300 to the Missouri Car & Foundry Co. and 300 to the Mount Vernon Car Manufacturing Co.

The Bangor & Aroostook road has received from the Jackson & Sharp Company, of Wilmington, Del., two passenger coaches, one combination express and baggage, one express, one baggage and one combination mail, express and baggage car.

The Ensign Car and Manufacturing Company of Huntington, W. Va., have an order from the Norfolk & Western for 500 new box cars, for the quickest delivery possible. The rush of business in coal and coke makes this new equipment absolutely necessary.

The Ohio Falls Car Company, of Jeffersonville, Ind., has an order for a special car from the Magician Herrmann. It is to have accommodations for baggage and horses, with a capacity for five horses, three vehicles and the company's baggage, and will cost about $6,500.

The Kansas City, Pittsburgh & Gulf Railway has placed an order for 300 box, 100 coal and fifty platform cars, the Barney & Smith Car Co. and the St. Charles Car Co. getting an equal division of the work. The Chicago car roof will be used on the box cars.

The Northern Pacific is building some 70,000-pound box cars at their shops; 100 at Edison (Tacoma) and fifty at Brainerd. These cars have a length over end sills of forty-two feet; width over side sills, nine feet one inch; height inside, seven feet eight and three-fourth inches; thirty-three-inch cast wheels, Westinghouse air brake, M. C. B. coupler; two coil springs, 6 x 8 inches, placed side by side, for each drawbar; journal bearings, M. C. B., 4½ x 8 inches; iron roof, Dunham doors and National door fastenings.

All the office force of this paper unite in singing thanks to Mr. A. Major, of this city, for one of his filtering water coolers. This device is made of glass; the ice does not come in contact with the drinking water but floats in a vessel in the cooler and only keeps it at spring water temperature. Drinking Croton water through one of these coolers is such a pleasure that we expect it will reduce the number of licenses taken out just as soon as the people get to know where the maker is and how much a cooler costs.

PRACTICAL LETTERS FROM PRACTICAL MEN

Railroading in South Africa.

Editors :

When I called at your office last October, up near the sky, on the fifteenth floor, I intimated my intentions of going to South Africa. I have been here about seven months and have run a locomotive on the Netherlands Railway four and one-half months of that time, and can now speak a few words from experience.

To inform the many friends and acquaintances in railway circles who have asked me to write to them in regard to railroading here, especially in Los Angeles, Cal., where your valuable paper is extensively read, I ask you to publish this letter in LOCOMOTIVE ENGINEERING.

On arriving at Cape Town my first move was to visit the Cape Colony Railway shops and learn how railroading was done here, and, above all, to find out what wages were paid to engineers—drivers, as they are here called.

The shops are about five miles from Cape Town. After procuring a permit from Her Majesty's servant at the general office, I went to the superintendent's office at the shop, presented the sealed envelope I had, and in a few moments was escorted through the works by what the superintendent called one of his best men, and, in my humble opinion, he was a mechanic in every sense of the term.

Everything about the shops was quite modern. They rebuild all their engines, make any kind of castings; in short, have facilities for doing any kind of work necessary for their road. No new engines are built here. All, except two consolidation Baldwins, are imported from England. A large compound engine drives the machinery in the different departments of the shops.

There are about 2,400 miles of road in the Cape Colony and Natal. Schedule time of passenger trains, except locals, does not exceed 17 miles per hour. Coaches are all lighted with electricity. Wages of workmen in the shops, and enginemen on the road, are very small. Engineers get 11 shillings ($2.77) per day as the highest pay, and some overtime. It is hard for them to make over £22 ($110 U. S. money) per month. Farther in the interior they get in a little more overtime, and in many places food is expensive and of inferior quality. Mechanics in the shops receive about the same pay as the engineers. When business is slack the youngest men in service are dismissed. Twelve drivers were discharged in January. Firemen are sometimes promoted, provided they pass the required examination. The best man is selected; no seniority. Rigid rules and strict discipline are enforced in all departments. None but skillful mechanics need expect to hold positions, unless it be an apprentice, as the chargemen are very particular as to workmanship. Engineers must wash out the boilers of the engines they run and grind in all little cocks and valves in the cab—or foot plate, as it is here called. The simple vacuum brake is used on all the Cape and Natal lines.

The Cape line extends as far as the Vaal River, the northern boundary of the Orange Free States. The western branch, however, extends farther north as far as Mafeking, west of the Transvaal border.

After crossing the Vaal River at Vereeniging we get into the Transvaal Republic, where the Nederlandsche, Zuid-Afrikaansche Spoorweg Maatschappij has full swing, a monopoly on railway transportation and construction of railways.

STANDARD LOCOMOTIVE, TRANSVAAL REP., SOUTH AFRICA.

I will give a few facts about railroading on this company's lines, as I run an engine for them, as above stated.

The Netherlands Railway Company has all new machinery; the engines are built of good material and substantially put together, but very badly designed. I will inclose photo to give you an idea what they look like. The driving journals are 4 inches diameter; they burn up at a speed of 18 miles an hour; steam pipes are placed outside the smokebox a distance of 3 feet; no way of lubricating valves or cylinders while working steam. Cylinders and valves are frequently badly cut. I have seen large grooves ¼ inch deep cut in valves and cylinders on engines not thirty days out of shop. The valve motion is similar to that on engines built by A. J. Stevens on the Southern Pacific at Sacramento, Cal. One large and one small coal bunker in cab; they hold 4½ tons. Fuel is not good; a large percentage is stone. Fires must be cleaned every few miles; fireboxes are provided with large drop-grates, and ash pan is cut away so no hoeing out need be done, otherwise much time would be lost in cleaning fires and ash pan.

Two classes of engines are used—fifteen 25-ton engines, and, so far, 110 47-ton engines. New ones are coming from Holland on every steamer. Sixty-five were recently ordered. They are put together in Pretoria, the headquarters of the company. These engines all have trailing bogies and no trucks to guide the driving wheels; wheels all have flanges. Considerable jerking and lateral thumping against the rails is felt when going around short curves.

No labor has been spared in making a good track. Every foot is stone ballast. Some of the ties are wood, others are iron. The road has many short curves. At all stations switches are thrown from platform or signal tower. Switchmen give no signals, they blow a horn. Trains are moved by telegraphic orders. No train can leave a station until the regular whistle signal has been given by station chief. Average speed of all trains is about ten miles an hour. Cars (wagons, they are here called) are about twice as large as a heavy two-horse wagon; their capacity is from five to seven tons. Double trucks are used for heavy material. The automatic vacuum brake is used; 20 to 25 inches of vacuum must be maintained to keep brakes released; destroying the vacuum applies brakes—it works good on short trains, but no earthly good on long trains. Very few cars have hand brakes; small stones are much used to stop and block them when shunting.

All rules and regulations, time-tables, etc., are printed in the Dutch language. I procured a Dutch-English dictionary with which to interpret some of the most important rules; in about a month I could *paralyze* Dutch.

Pay of engineers varies all the way from £12 10s. to £20; the latter is the highest. All engineers who have run on other roads commence with £15 a month. If a man gets along a whole month without losing time with a train, he may get a raise to £17 10s. ($87). The next increase, to £20, is hard to get, however good and efficient a man may prove himself. In addition to the regular standing salary two shillings per 100 kilometers is allowed; in busy time 4,000 kilometers a month can be run, which is £4. Then £3 per month bonus is paid to all employés for good behavior, and there are oil and fuel premiums, which on an average amount to about thirty shillings ($7.50). These premiums are not paid until three months in service, so when a man leaves the service he stands a feeble chance of getting three months of his premiums. The standing wages are paid whether one works or not, but they generally manage to get twelve hours every day, and sometimes sixteen.

To partly counteract these benevolent premiums, which are paid in addition to the company's liberal salaries, they have a system of fines. Employés are fined for many trivial things. I will attempt to give but a few:

Arriving at a station ahead of time, one shilling a minute. Loss of time, two days' premium—four shillings. If loss is an hour or more the fine would be £2 or £3; depends some on the importance of the train. Should the engineer fail to get his report from the conductor, and happen to turn it in too late (10 A. M.), he is fined half month's premium. In some roundhouses bulletins are posted to that effect. Men are fined for what they term "cheek;" sometimes pretty heavy, too. Fines are imposed for killing stock on the track, but not for killing Kaffirs.

The officers seem to take permission to fine men for whatever cause they wish to. I was fined twice for one offence; reported by a policeman and station chief for fast running between Park and Jah Brg. stations, a distance of one-quarter mile. Had there been three or four more reported me, several fines would have been imposed. When the master mechanic told me of this, I said it was the first fine I ever paid, and did not intend to pay any more; then he showed me the list of men who were fined. Everyone on the two divisions had from £1 10s. to £4 10s. against them. The master mechanic said, "Your fine is nothing compared to these." I replied, "It may not be to some men, but that fine business won't work with me."

The above will give an idea of how men are fined. Part of this fine money goes to the hospital fund, and part—perhaps the greater part—goes to the various officers. The money that is added to the hospital fund makes the officers appear charitable—gives the fine system an air of justification, as it were. A six-pence on every pound paid to employés is also deducted for the hospital fund. The object seems to be to have the fines absorb the greater part of the premiums. In many cases it takes all. One of the high officials was heard to say, when an engineer complained for being fined £3 for loss of time, "I know this fine is unjust, but that is the rule and it must be enforced."

This is one way of respecting human rights. Every man on entering the service signs a contract. No more can be collected than is stipulated in the agreement, which is never above £15. If the pay is raised no new contract is made.

Some perhaps will wonder how the company can get men to work for them. They do; but all except the contract men from Holland do not stay long. Many of the Hollanders are not worth any more than they get. On many American railway systems they would not be hired to push a wheelbarrow. I never was among such a drunken set as these Hollanders, nor did I ever see so many empty gin bottles at roundhouse and stations. I believe in ten years' time the company will be able to reballast their road with broken glass.

Engineers are brought from Holland under contract for four years at £12 10s. ($62) per month. Twenty recently arrived; another drove is on the route. Many are sent on the Delagoa Bay division, where they die like tomato vines on a frosty night. I ran on the above division a month and resigned. The pay there is no higher than in the healthy region. In that low country, fruit and vegetables are scarce, food generally unwholesome, and meals half-crown (60 cents).

The Netherlands Railway Company could, without doubt, pay the highest wages of any company in existence, as theirs is one of the best-paying roads in the world. I have been told, and from very good authority, the road last year paid 85 per cent. on the capital invested. The Government guarantees them 10 per cent. on their bonds.

Mr. Fillis paid £350 to have his circus train of about twenty cars hauled a distance of 84 miles last March. A M.M. also boasted to me once of the great amount of money the company was piling up. I promptly asked him why they did not pay their men decent wages and get a few good, experienced men to run their machinery. It should be remembered that the purchasing power of money here is not more than 70 per cent. of what it is in the States, and in many places not more than 50 per cent., except when you buy labor.

There is yet another chance here to railroad—Biera. No doubt many of my friends have heard that engineers get $200 per month in Africa. About 600 miles north of Delagoa Bay, on the Biera Railway, about this sum was paid—£40 for engineers and £30 for firemen. About six months ago, however, the pay was cut to £30 for engineers and £20 for firemen. The Biera road extends through the Pungive flats, a distance of about 100 miles; it is a 2-foot gage; twelve engines comprise their motive power; five cars constitute a train. This is the line Mr. Cecil Rhodes is endeavoring to extend into Matabele and Mashonalands to Victoria, but is making very slow progress. It is through a most deadly, fever-infested region. No one escapes it. About four months ago seven engineers came from there (Biera). Five died on shipboard; the other two, with whom I became acquainted, were very ill, their health permanently injured, as it takes years to get this fever out of the human system.

I also met an engineer from the Northern Pacific, who just returned from the Biera Railway. It cost him every cent he had while in the hospital, and is now what is commonly termed a walking skeleton. Railroading in South Africa is not as good as many people in the United States have often heard. I do not wish to discourage anyone from coming here; I am just giving facts as they are.

I will not take up any more space, as what I have said will give a fair idea of the condition of things on railroads in South Africa.

Let me say, in conclusion, as far as my experience goes, when a man leaves the United States, unless he has unlimited means, he departs from God's country and the workingman's paradise.

PHILIP E. STELLWAGEN.

Johannesburg, Transvaal Republic, South Africa.

Adjustment of Pressure Gages.

Editors:

I have been greatly interested in an article in your November number, signed "O. H. R.," on the subject of pressure gages, and while there is a hint at many troubles with which we are all familiar, there is much trouble caused by "adjusting" too much. I know of gages in use for twenty years and accurate on test. I have in mind, at present, one prominent engineer on one of our great railroads who had in use for twelve years a certain gage of standard make, and who took it to the shop to be tested, going with it himself to see that it was not "examined to see the wheels go round." It split the line at every pressure, and was put back in service without even oiling. There are many gages made so cheaply that the dials are printed in duplicate (an evidence of inaccuracy), and some of them even have paper dials, but they are used mostly on portable engines, selling at 25 cents per bushel, more or less, as the occasion demands. [The 25 cents refers to the price of gage and not the portable engine.]

In his reference to the construction of

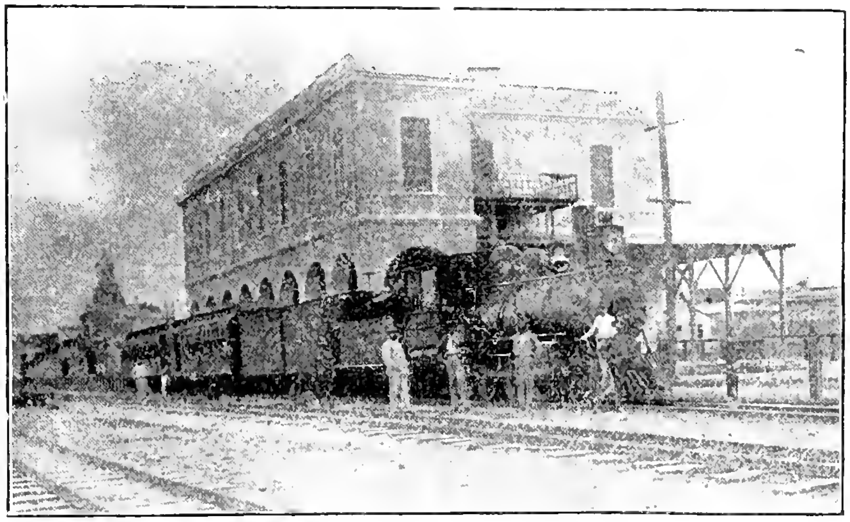
the well-known "Utica" gage he does not get at the true inwardness of the spring.

It is not merely the motion of the top of the spring that transmits the pressure. Of course, the motion comes from that point, but the spring is supported at the center of the bottom head, and as the bottom-head moves just as much as the top one, the top one is lifted not only for its own expansion but for the bottom head as well. For example: if the motion of the whole spring is $\frac{1}{16}$ inch each head expands but $\frac{1}{32}$ inch.

The ready test outfit shown was made and used by my father over twenty years ago, and was proven to be inaccurate and abandoned, and it was made in a much more complete form. Glycerine was used as well as every other medium he could think of, and the trouble was friction in the plunger. The piston was even made longer, guided at top and bottom and relieved at the sides, and the load was applied on the bottom head to stop any tendency to cramp and bind. When it was working absolutely correct (as supposed) it was compared with the only absolute test, an open tube of mercury, and recorded by electricity, and found to be out just enough to condemn it. The only convincing test as to the accuracy of the test gage is the safety-valve having a knife-edge opening measuring 1 inch by the micrometer gage, the opening being square. Load applied then means pounds per square inch. W. E. Wood.

Utica, N. Y.

[Undoubtedly there are some steam gages that are absolutely correct and remain so for years. Once in a thousand times one can find a Waterbury watch, costing $2, that keeps perfect time, yet no one would trust a "Waterbury" as a regular thing. All steam gages should be tested regularly. An open column of mercury is a cumbersome thing to maintain in a shop. We believe that the best *practical* test device is a weighing machine of one kind or another. In the device shown last month there is undoubtedly some friction on the plunger, but if the weights are central and the plunger turned around by hand once or twice in a test, we believe that it is as correct as necessary—within the fraction of a pound. The weighted tester is the only one we know of that will remain in its normal condition and attend to business without more care than is ordinarily given in a roundhouse or shop.—Eds.]



Station at Cartagena, Colombia, S. A.

Notes from Colombia, S. A.

Editors:

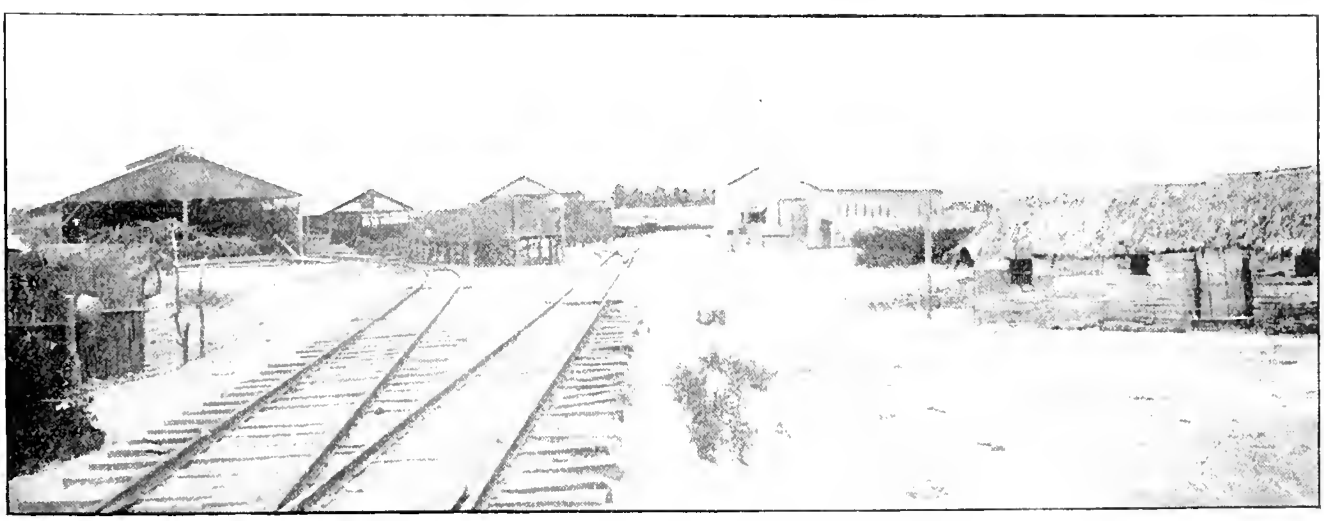
The Cartagena-Magdalena R. R. of Colombia, S. A., was built by American capital, mostly Boston. It runs from the harbor and town of Cartagena, on the coast, to the town of Calamar, a point on the Magdalena (the most important river in this country), about 200 miles above its mouth, and was built to facilitate the transportation of freight to and from the interior, in connection with a line of steamers on the above-mentioned river.

The road is 106 kilometers or 65 miles in length, 3-foot gage, 45-pound steel; heaviest grade is 1 2½ per cent. and sharpest curve 8 degrees, road is ballasted with coral, volcanic rock and sand; has about 130 trestles and one iron drawbridge. We have nine locomotives, all American build.

There are four Rhode Island hogs, fitted with Westinghouse air brakes, balanced valves, etc.; three Porter moguls, with steam brakes; one Brooks, no brake, and one Porter coffee-pot, Armstrong brake (used on the wharf for shifting).

All conductors and engineers are Americans, and so are some of the operators; section men and brakemen are natives and Jamaicans. Wages are fair, but not up to average paid in the States. The road is not doing much at present, but hopes to have a rush before long.

The city of Cartagena was built in the year 1500 and something, and is entirely surrounded by a large stone wall, which was a big undertaking when you consider the fact that all the stones had to be brought a great distance by boats, as there are no stones near the city. The natives are a very quiet and pleasant race, and are not at all treacherous, like the Mexicans. They have their little revolutions every



Typical Scene on the Cartagena-Magdalena R.R.

once and awhile, but as it amuses them and hurts nobody, it cannot be considered as a bad trait in their character.

The upper classes, who are descendants of the Spaniards, dress very similar to the English and Americans; the women are mostly good-looking and all have beautiful hair. The peon, when he dresses up for Sunday, generally wears a clean undershirt, a pair of white pants, creeping-Jesus shoes (as they call sandals) and a cane.

The coast rises gradually until you strike the coast range of hills, about twelve miles back; these the railroad climbs, and descends on the other side to a plateau which extends to the river. The country is rolling and full of hog-wallows. The climate is very healthy on the coast, and it is not hot enough to be uncomfortable, as there is a trade-wind nine months in the year and the nights are always cool. The officers of the company are: Francis R. Hart, president; Gordon Abbott, vice-president; J. T. Ford, general manager and chief engineer; F. B. Fearon, treasurer; T. Shipley, secretary; W. R. Mansfield, superintendent of transportation; M. Mulverhill, superintendent M. P. and M.

B. WOOSTER.

Cartagena, Col., S. A.

Location of the Master Car Builders' and Master Mechanics' Conventions.

Editors:

Several years ago the method of selecting the places for the assemblies of the M. C. B. and M. M. A. was under discussion. The plan then in vogue not being satisfactory to a majority of the association the plan was changed to the present one, which is not giving the general satisfaction desired, which is quite evident when the expression in convention was against going to Saratoga next year, and the Joint Executive Committee decided contrary to the conventions, and take us to Saratoga again. It seems that Saratoga should be given a rest for a while, as we have been there every alternate year for the last ten years. Not but what it is a good healthy place to go to, good water of all kinds and plenty of it, but too much of the good thing is nauseating.

The action of the "high joints" may be attributable to the fact that a majority of them live in the vicinity of Saratoga, and are not used to going very far from home. It is to be hoped that this is not the case. A plan that would no doubt meet with the approval of a majority of both associations is as follows: Divide the country into, say, four districts, Eastern, Middle, Central and Western; the Eastern to cover the territory east of the Hudson River, which contains about 10 per cent. of the membership; the Middle to cover the territory west of the Hudson River, the Atlantic States, and west to and including Pittsburgh, Buffalo and Toronto, which contains 30 per cent. of the members; the Central to cover the territory west of the Middle district and east of the Mississippi River, containing 40 per cent. of the membership; the Western all the territory west of the Mississippi, which has 20 per cent. of the members.

In order to do justice to all the members, the meeting places should be divided in accordance to the distribution of membership as above, which would be about as follows: For instance—first year, in the Central district south of the Ohio River; second year, Middle district north of Pennsylvania Railroad; third year, Western district south of the Missouri River; fourth year, Central district north of the Ohio; fifth year, Eastern district; sixth year, Middle district south of Pennsylvania Railroad; seventh year, Western district north of the Missouri; eighth year, Central district south of the Ohio; ninth year, Middle district north of Pennsylvania Railroad; tenth year, Central district south of the Ohio. Leave the choice of place to the Joint Executive Committee, but to be within the lines prescribed.

The argument has been advanced that it is not possible to obtain terms and accommodations outside of such places as Saratoga and the Thousand Islands. This argument won't hold water when such places as Denver, St. Paul, Milwaukee, Buffalo, Louisville, Boston, Baltimore and others are offering large bonuses for larger conventions than the Master Car Builders' and Master Mechanics'. If one hotel cannot be found large enough to hold us, take two, or adopt the plan advanced at the last meeting of the associations—that one hotel or hall be named as headquarters of the conventions, and that the members go to whatever hotel they please. We will have to come to something like this soon, as the conventions are getting too large for any one hotel to accommodate. We will have to do as other large meetings do.

One of the leading reasons for holding the conventions as suggested heretofore is this: The annual convention weeks are the only outing a majority of the members have during the year; many of whom take advantage of this occasion to take in everything in sight that is new, interesting and instructive in their line of business. To go over the same route every year becomes monotonous.

Another is: It is imposing on the generosity of our friends to ask the same favors repeatedly, as we must do when we meet in the same locality continuously. No use riding a free horse to death. Another very important reason is: That whenever the convention has been held in a new locality, large additions have been made to the membership. No doubt this will be the result again, if we move out a little more to the West and South.

Considerable complaint has been made by members that rooms could not be secured for themselves even a month ahead, the choice being secured by outsiders in many cases as soon as it was known where the convention would be held.

Either of the following plans should be adopted in order to give satisfaction.

The Committee of Arrangements to have a plan of the hotel, and application to be made through the committee, or a place or city chosen for the conventions that has plenty of hotels, one of them to be named as headquarters. The members to have the privilege of selecting their own hotel.

That the present system is unsatisfactory is becoming more evident every year.

JOHN D. MCILWAIN.

Pittsburgh, Pa.

Steam Heat on the P. R. R.

Editors:

For some cause the friends of LOCOMOTIVE ENGINEERING go very shy on matters pertaining to the steam heating of passenger trains. While the subject of steam heat does not interest all railroad men, as the air brake and some other subjects do, it is a very live topic with a large number of men at the present time, and those who have to look after the success of the steam heat apparatus would be glad to know what success others have with steam heat.

On the P. R. R. lines we have in use two systems of steam heat, *i. e.*, what is known as straight steam and the "return system."

The straight steam system appears to be in favor with most all railroad men, as they claim it gives less trouble than does the return system.

In looking over the records of last winter, I find a greater number of failures charged to straight steam than is charged to the return system. I believe when the return system is properly understood by those using it, that it will give less trouble than will the straight steam system.

In educating men to care for the return system, we run against a curious trouble—that is, experience has taught everybody that the success of the air brake depends largely on what the engineer has to do. So with steam heat, when cars fail to heat properly, everybody jumps on to the engineer for the "cause why."

To make the return system a success, the engineer has but two things to look after: First, to keep a supply of steam in the main steam pipe, "left side of train;" second, to keep the vacuum pump and condenser working properly, so as to take the steam condensation from the return pipe, "right side."

For the engineman to do this, the trainmen must so regulate the steam into each car from the main supply pipe that in its travel through the radiating pipes it will heat the car, and by the time the steam reaches the return pipe it will have condensed and gone back to the engine as hot water.

To heat cars properly in severe cold weather will not depend on having a very high steam pressure in the train, but rather the keeping the steam in rapid circulation.

When trains are too cold, or when overheated, we should stop going to the engine for more or less steam, as the case may be, but try and regulate the valves in the car, so that the steam gage on engine will show to the engineer how much steam is required to heat the train.

J. R. ALEXANDER,
Air-Brake Inspector P. R. R.
Altoona, Pa.

Ironclad Rules.

Life and property have frequently suffered from the loose, irresponsible methods pursued in the operating of railroads on this continent. Railroad companies and the community at large have been the gainers by the control put upon railroads by railroad commissioners and other authorities; but it is possible to carry restrictions too far. All the most approved appliances for the promotion of safe operating of trains should be insisted on for roads doing a heavy business, but roads struggling along to pay expenses while developing the resources of thinly settled districts ought to be permitted to operate in the cheapest possible manner.

The obstacle to enterprise caused by ironclad rules applied to railroads has been rather strikingly illustrated in Great Britain for many years. The railways there are all very strictly under Government inspection, and no railway can be opened for traffic until it has passed the inspection of officers appointed by the Board of Trade. These people insist that no railway shall be opened without being in a condition to operate express trains safely. No matter if the road does not run more than one train a day, the "standing rules" about signals, switches, highway crossings, bridges, etc., must be adhered to.

There is chronic depression in the agricultural districts of the British Isles, and certain public men hold that great benefits would result from the use of cheap railways to bring agricultural products to market. Railways of that character cannot be opened without an Act of Parliament being passed to remove restrictions now imposed by the Board of Trade rules. There is agitation now going on in favor of the required legislation.

The unyielding strength of rules and red tape, that are old characteristics of British officialism, is still as potent as it was before Dickens attacked the Circumlocution Office. They have spread their claws over railway affairs with evil effects. Here is an illustration of how the power of small officials works on the community:

A large land proprietor and mine owner built a railway through his own property. One locomotive and a few cars were sufficient for the needs of the new railway, and the owner did not think that an elaborate system of signaling and interlocking switches was necessary. When he applied to the Board of Trade for permission to begin operating the road, it was refused on the grounds that the standing rules about signals, etc., had not been observed. The gentleman was influential with the Government, and after months of effort succeeded in obtaining permission to operate the line without signals, etc. His business increased rapidly, and the use of a second locomotive was necessary. Permission had to be secured from the Circumlocution Office to use a second locomotive, and so many objections were raised that the Prime Minister was appealed to. He used his influence with the Board of Trade officials, and the best terms these barnacles would consent to were that the second locomotive might be employed so long as both locomotives belonging to the railway were not under steam at the same time.

Free Passes to Visit the Exhibition.

Receiver H. M. Comer, of the Central R. R. of Georgia, has issued an order giving each of the employés in the mechanical departments of the Central Railroad a five days' leave of absence, with full pay, in order that they may be enabled to visit the Atlanta Exposition. They are also given free transportation for themselves and families.

In the summer time, when many of the men were put on half time and others were temporarily laid off, they remained faithful to the interests of the Central, and it was considered that their loyalty was entitled to some recognition. The men will be allowed to go a few at a time, as they can be spared from their work, until they have all had an opportunity to see the Exposition

The employés in all departments are being given time off, as they can be spared, for the purpose of visiting the Exposition. The officers of the road have been exceedingly liberal in this respect, and their action will undoubtedly be heartily appreciated.

Are you working on an invention to charge auxiliaries while brakes are on? Better buy "Evolution of the Air Brake" and see what has been done before you invest any money.

The Crosby Steam Gage and Valve Co., of Boston, Mass., have brought out an electrical attachment to their well-known steam-engine indicator. The purpose of this new attachment is to enable engineers to procure simultaneous diagrams from compound engines, taking cards at the end of each cylinder. The attachment appears to be very well designed, and will, no doubt, do the work required perfectly. Anyone interested in a device of this kind can obtain full particulars by applying to the Crosby Co.

Jim Skeevers' Object Lessons.

Sixty-nine Years of Useless Work on a Clinker Pit Automatic Coal and Sand Shovelers The Laborer Worthy of His Hire The Lady or the Tiger?

Did you ever notice how things go by threes? Jim Skeevers went down to the roundhouse one night last summer, fell in a pit, and was carried home—that was three on Skeevers.

While Jim was laid up the general officers of the Midland visited the shops. When the general manager is absent, Massey, the general master mechanic, always speaks in the first person—"I" did so-and-so, "I" made this change and "I" saved so much. It was an "I" day, and Massey showed up all the kinks devised by Skeevers and said "I" every time. The Midland people were impressed with the results, and, being progressive, and not adverse to "taking men away" if they could better their own service, the manager wrote Massey an offer of the position of superintendent of motive power of the Midland at better pay than he was getting where he was.

Massey had no idea of going, but thought—short-sighted man—that the G. M. would "see" the pay offered, to keep him. But Mr. Wider congratulated him so hard and advised him so strongly to take it, saying that he and Skeevers would worry along somehow, that really Massey had no choice but to accept—that was three on Massey.

It was also three on the Midland.

When Massey's resignation was safe in his desk the general manager smiled a satisfied smile, shook hands with himself and took up his pen.

He wrote a notice that the position of M. C. B. was abolished. Then he wrote another that James Skeevers was appointed Superintendent of M. P. and R. S., *vice* John Massey, resigned, and took them in to the first vice-president for approval, got them signed and had one hundred copies of each printed.

Two days afterward they were posted in all shops and offices on the road—then he hopped into his buggy and drove up to Skeevers' house.

Skinney was sitting in one chair on the porch, nursing his game leg in another, and reading LOCOMOTIVE ENGINEERING.

After the usual courtesies, the old man pulled out a copy of the notice and handed it to Skeevers with much the same feeling that a man has when presenting a child with a new toy. Skeevers knew what the notice said well enough, but he read it through gravely and, turning to the general manager, said:

"Mr. Wider, I thank you for the compliment paid me in this appointment, but before accepting it I want to talk with you about it a little; I have never said anything about wages before, but may I ask what your intentions are as to pay?"

"Oh, it pays better than usual. Massey got $3,000 a year."

"And Mr. Green, the M. C. B.; what did he get?"

"Eighteen hundred."

"And you are proposing to pay me ——?"

"Three thousand."

"To do Mr. Massey's work as well as Mr. Green's?"

"Well, you'll oversee everything on wheels, of course, and——"

"Well, Mr. Wider, as I said before, I am obliged for the compliment, but I don't want the job at that figure."

"Don't want the job?"

"No, sir."

"Good Lord, man, what do ye want? Ain't the earth good enough for ye, or shall I telegraf for a couple of planets, or something? Why, there ain't a man in the department but what would jump at the chance."

"I know it, sir; and that's just what's the matter; they are so eager for position that they have disgraced the job of master mechanic to the lowest round of the railroad ladder. The heads of this department do more work, take more responsibility, have to have a longer training and more experience than for any other job on a railroad, and—get less pay for it. Now, I can't reform the whole system of disgrace, but I can keep one sucker from getting into the hole, and his name is Skeevers."

The general manager was dumbfounded. He looked at Skeevers for ten seconds, and then said: "Well, I'll be ——; say, what do you want, anyway?"

"Mr. Wider, continued Skeevers, "you don't think anything at all of paying your general superintendent $6,000; your division superintendents get $250 a month, but your master mechanics get $150. Our general superintendent was an operator, then a dispatcher—he's a good man, but he has had less than ten years' experience as a railroad man, and all that in an office—your division men all came from conductors. Two master mechanics were engineers here of many years' experience, good men, both of 'em; one was a machinist, and he's a daisy. These officials have a larger force of men under them than all other officers combined. They can save or waste more money than any other officers, and every one of them have introduced reforms within a year that saves more than their wages, yet you think that they are well paid. Why, sir, not one of 'em but what has engineers under him that get more money. You won't pay them more because it's the custom to pay the best men the worst. As for me, I have made up my mind to go braking—I'd rather get into the transportation department, where the hours are shorter, private cars possible, and pay higher—to say nothing of the work being lighter."

"Well, Mr. Morality—not that it'll make much difference—I'd like to inquire for what consideration you would condescend to take charge of our motive power and rolling stock departments for—say—a year?" asked the general manager, with half-mock formality.

"Well," said Skeevers, musingly, "I don't just like this cold-salary figuring, but since you've asked me I'll make you two offers: First—I'll take the job for one-quarter of the saving I make over the past year's management; that, I figure, will be not less than ten thousand dollars for me. But, if you like the straight-salary scheme, here's a second offer—I'll take the job for $5,000 per year, if you will pay my division men the same as you do division superintendents. I want 'em to hold up their heads and 'feel their oats,' as horsemen say."

"Why, Mr. Skeevers, our president wouldn't listen to it for a moment; he'd hold up his hands in holy horror and tell me what the other roads were doing, and he'd ——"

"Oh, no, he wouldn't, Mr. Wider. Do you remember when we took him over the road and you tried to tell him how much we saved by some shop changes, and how he stopped you and what he said?"

"Well, what did he say?"

"He said, 'Mr. Wider, that's what we've got *you* for. Don't, please, bother me with details; *what I want is net results*. Come to me with them.' That's what he said. You just ignore precedent once; pay this department what it deserves, and I will give you some *net* results to take to the 'Sphinx,' as you call him—he won't ask what you pay your superintendent of motive power or your master mechanics—it's *net* results he wants."

The old man poked a morning-glory blossom with his cane for ten minutes before he thawed out; then he said:

"Well, Skeevers, this is a clean case of highway robbery, but you are the dog-gondest man for having your way I ever run up against. Your object lesson on pay is good enough, but I tell ye there must be some *net* to show for this—some object lessons."

"Thank you, Mr. Wider; you come up to the shops next Saturday, week, and I will show you one object lesson, if not two, that will help pay this extra; and, by the way, I should like very much to notify my master mechanics of their raise in pay, you to approve letter."

"All right, Skeevers—'er, by the way, did I hear you say that you had a small, brown box that you wanted me to examine?—a paper-trimmed box—with a tack for catch—paper hinges—and a—ah! thank you, Mrs. Skeevers, you are a thoughtful woman; anyone would think these were dollars instead of cigars, the way your husband keeps 'em hid."

That was three on the old man, so you see the whole thing went by three's.

In due course Skeevers notified his three master mechanics that "on account of faithful services and the intelligent use of their brains, they had shown themselves worth more to the company, and the company was pleased to notify them that hereafter their pay would be increased," etc. Of course, that discouraged 'em wonderfully.

A week from the following Saturday the old man showed up at the shops and entered Massey's old office—things were changed.

The old M. C. B.'s office at the car shop had been shut up and the two best clerks brought to Skeevers' office; the three others were relations of Green's, and Green was a brother-in-law of Massey's, and Massey had made places for 'em all on the Midland. Skeevers had saved four men, counting Green, by the deal—that pleased the old man, for the pay-roll was the bane of his life, and the one thing that the "Sphinx" looked into and commented on—wanted to know where the *net* was.

As Skeevers steered him toward the roundhouse they went through the boiler room.

"Saved two coal-handlers here," said he; "we used to dump coal into these big bins on the side of the house, it was thirty feet from rear wall to boiler fronts, had to keep two men wheeling coal ahead. We built a frame-work in there of old bridge timbers and planked it over on an incline, and now all the coal dumped slides ahead to shoveling distance. Bins only hold half the coal, but that don't count; we have lots of it in the yard all the time."

"Good idea, good idea," said the old man.

At the sandhouse Skeevers pushed the door open and disclosed an old, crippled, pensioner sitting before the drier.

"We piped this place for air," said Skeevers, "and put false bottoms in our bins, so that the sand, as unloaded from the cars, will slide toward the drier; we elevate it by air and draw it into sandboxes instead of putting it in by hand with buckets. All this man does is to keep up the fire and move a lever now and then; this belt of buckets fills the drier, and the dry sand runs to the pressure tank, from which it is elevated—saved the work of three men."

"Object lesson number two," said the general manager. "Very good; why don't you duplicate this plant at Granger and the other engine terminals?"

"I can beat that by putting in another drier here and drying all the sand for the system; or, if you will buy air-jet sanders for the engines, this drier will take care of the whole system, save buying half the sand and hauling and handling it, beside wiping out five sandhouse gangs."

"Yes, but we've got the driers."

"Certainly, but labor and the cost of extra sand goes on forever—I meant to get those sanders before you knew it from the saving here; but here we are; this is what I wanted to show you.

"Now, this roundhouse has been in use for twenty-odd years; for all that time, night and day, two men, and sometimes three, have been working at this cinder pit.

"Look at it; it was forty feet long and four feet deep, and for twenty-odd years every engine that went into that house has dumped her ash pan and cinder hopper here; the men have put a barrel or two of water on to the cinders, and then got into the pit and shoveled them out on to the ground. When the pile got so big it was in the way, some cars were pushed into this side track over here—twenty feet away—then the cinders were shoveled up into them and hauled out into a siding; when there were ten loads the road department, after much telephoning, would consent to take them out where they wanted them and unload the cars. Five to seven handlings, depending on the weather; for in winter the wet cinders froze in the pit, the pile and the cars.

"Long ago I determined to do something with this place, and it's the first thing I tackled when I got back to work. After I was half done I found in the pigeon-holes of my desk no less than five letters from yourself, the general superintendent, the roadmaster and the engineer, telling why this very change could not be made; but it's made, and it has cost none of the departments a cent. I dug this pit with the cinder-pit men and the laborers I saved in the sandhouse and boiler room; those cast-iron posts on one side Massey had made for the purpose more than a year ago, feeling sure you would let him put in the pit. You refused, and he hid the castings.

"Now, you see, we have dug a pit this side of the cinder pit deep enough to drop the top of a gondola below the bottom of the cinder pit, which has been half filled up. One man cleans the fires and hoes all the cinders into the cars as fast as taken out—no frozen cinder pit, no shoveling or piling up of ashes. When these two cars are filled—and we find they are filled in about three days—we take an engine and throw them out into that spur. As long as we have cars I don't care when the road department get rid of them.

"That wall we made of old material, with the exception of the cement; we have saved three men's work and no end of trouble—what do you think of it?"

The general manager looked, but Skeevers couldn't tell from his face whether he was pleased or displeased—he had become a Sphinx himself.

Skeevers continued: "The engineer said we couldn't get the track in on this curve, the foundation wouldn't stand, and that the car pit would freeze up. The roadmaster said it would cost his department $150 to dig the pit and lay the track. The superintendent said it had done well enough for twenty-three years, and he couldn't see the use of investing five hundred dollars in an 'innovation,' and you said we couldn't afford it; and all the while the machinery department was hampered by it and went on paying three laborers for twenty-three years because we couldn't spend, say, $200. Just think of it; we have paid a man's wages for *sixty-nine years* for want of that pit improvement."

Then the Sphinx thawed out: "And this is official object lesson number three, hey? Well, Skeevers, it's a good one—a devilish good one!"

"I don't call this an object lesson at all; it's an incident of shop management. The real object lesson I hoped you'd see does not seem to have struck you at all."

"Ho, ho!" said the old man, "gettin' thick-headed, am I? Well, damme if you don't take the cake—but maybe you ain't so far wrong—the pit's a good thing; what else have ye got hid? Where's the lesson?"

"You think the pit a good thing; do you approve of my building it?"

"Yes; why, certainly. I can see on its face that it'll save money."

"Well, then, Mr. Wider, it seems to me that the object lesson lies in that fact. I would call your attention to your letters, showing that at five different times you have refused to fix this pit. Mr. Massey asked your approval of or permission to do everything. His only idea of getting the pit fixed was to have trackmen dig the pit and lay the track, masons to build the wall, and engineers to plan—I did the whole job with my own laborers. You had refused to build the pit, but never refused to let us do it ourselves.

"My old father used to quote a maxim something like this: 'Never tell what you are going to do—do it.'

"To call a manager's attention to every detail and change one anticipates calls for action on his part, and in times like these, action means to turn down anything that costs fifty cents. To ask advice calls for criticism, discussion, argument and delay. I am the best fitted of your officials to say what we need in the way of a cinder pit; I knew you would refuse to spend money on it and I have built it out of savings elsewhere; it has cost the company practically nothing.

"I know what our expenses for last year were. I propose to keep below that expense month by month and make some needed changes without money outlay before winter sets in. I feel sure the best way is for me to go ahead on that line and not bother you with details. Before the next annual meeting I will show you some *net* savings, but now is the time for you to say whether it shall be my way of working or Massey's. Of course, any change that costs extra money should go to you first; but about things like this, what do you say—the Lady or the Tiger?"

"Gimme a cigar," said the old man, and Skeevers fished one out of his vest pocket.

"Skeevers, it seems to me that the difference between you and Massey is that he talked about things and you do 'em."

"I hardly think you are fair to Massey; he was held down, never allowed to do things good or bad, but it was because of his everlasting asking *if* this and *if* that. The only *if* you ought to care about is *if* the head of this department is capable of taking care of it. It's *results* you want, not the way I think the results might be had if you would take the responsibility."

"Yes, you bet; *net*, that's what I want; some *net* results to show up when our president comes out. The Tiger is my choice, Skeevers; but, mind ye, a regular tame tiger, that a feller can lead round if he wants to; none of ye'r wild, yowling man-eaters that keep a feller up a tree half the time. And, Skeevers, you'll consult me before you incur any extra expense?"

"Certainly, and you'll be satisfied if my total expenses are less for each month of this year than they were for last?"

"Yes."

"And suppose I can show a saving over the previous month as well, for, say, a year, you won't interfere with the *how?*"

"No, nor the why *eyether*; get me some *net*. The 'Sphinx' will be asking for *nets* before he gets off his car; when do ye expect any in, Skeevers?"

"Got the books full of 'em now; there will be more *nets* than usual in the next month's report," said Skeevers.

And that night, as the old man finished telling the general superintendent about the interview, his highness asked if that was what he called one of Jim's object lessons.

"Object lessons?" said the old man; "why, sir, it's a whole liberal education. Sullivan, me boy, cultivate that man Skeevers; he'll be president yet—he *does* things."

Walking Is Healthy.

Mr Edwin Stone, manager of the Oregon Central, is not much in favor of throwing passes about promiscuously, yet he likes to soften his refusals with philosophical reasons. The refusal of a pass to an editor called forth the following letter, which appeared in the Portland *Sun*:

"There is nothing so important as the good will of your patrons, and there is no better way for you to secure this than by issuing passes to influential persons when cogent reasons are shown. Now, last week I wrote to Mr. Stone to send me a pass to Corvallis, as I wanted to go down to see some friends, and my legs are rather weak, but he, with a heart as hard as his name, replied that the trouble in my limbs was probably caused by not using them enough, and told me I could use the track to walk on. This sort of language is not calculated to create a friendly feeling, to say the least. I would like to have a pass to Corvallis—some time when you think of it."

The new machine shops of the Atlantic & Pacific at Winslow were completed and opened with a ball on November 14th.

A Good Form of Engine Report.

We show herewith the top and bottom of a report, full size, used on the Erie road for monthly report of engines from division master mechanic to the general office.

This is one of the best forms we have seen. The plan of designating the kind of repairs by letters and figures is good, and tells at a glance just what has been done or needs to be done to a locomotive.

This matter of having a good and effective form of reports for different records is an important one, and if any of our readers are using forms that save time, money or work, or have new features, we should be glad if they would send us copies of the same; they may do someone else good.

NEW YORK, LAKE ERIE

MONTHLY REPORT ON

.... *Division*,

LOCOMOTIVES

Engine Number.	Class.	Kind of Service.	Date Left Shop, Receiving Class 1 to 4 Repairs.	Date Boiler Tested.	Stay-bolt Examinations.	Boiler.	Fire-box.	Flues.	Tires. Wear in 32ds.	Tires. Thickness.	Machinery.

CONDITION

[Fifty lines.]

SUMMARY: Number in good condition ....
" " fair "
" " bad " ....

NOTES—CONDITION—G denotes in good order; F, in fair order; B, in bad order.
Summary should be made on last sheet only, and cover all locomotives.

REPAIRS TO BE CLASSIFIED AS FOLLOWS:

No. 1	—New boiler, and general repairs to machinery, expense,	$3,500 or more.
" 2	—New firebox, flues and " " "	2,500 to $3,500
" 2A	—New side sheets, flues, " " "	1,500 to 2,500
" 2B	—New crown sheet, " " " "	1,500 to 2,500
" 2C	—New back flue sheet, flues, " " "	1,500 to 2,500
" 2D	—New door sheet, " " " "	1,500 to 2,500
" 3	—Resetting flues and " " "	500 to 1,500
" 4	— " " turning tires and slight repairs to machinery, expense,	100 to 500
" 5	—Slight repairs, as facing valves, etc.,	100 or less.

A New Idea with Sense in It.

One of our valued friends, for a long time in the harness, now travels for a supply house, and has not given up his old propensity for "takin' notice o' things." He writes from Columbus, O., as follows:

For the past few days I have been looking after the interests of our company on the Columbus, Sandusky & Hocking R.R.

Among other things attracting my attention on that road has been the practice adopted by Superintendent Wm. Thornbergh, of having a locked box put up in the roundhouse, where engine and train men may ask questions by putting their queries on paper (the name need not necessarily be given); the answer is given in the form of a bulletin notice with question attached. The result of this practice is a more uniform understanding of the rules; it also gives the "kicker" a chance to get his work in.

In looking over the board this morning I was attracted by the originality of the inclosed answer, signed by Mr. Thornbergh, and thought that, perhaps, you might deem it worthy of publication:

Question. "*Are men on this road entitled to their rights? If so, why do they not get them?*"

Answer. Not knowing the circumstances that prompted this question makes it a little hard to answer.

However, I will say: Yes, we are all entitled to our rights; just what they are and why we do not get them is the essence of the question.

I believe, however, that our employers, if left free to act, will fittingly recognize all of us according to the measure of our faithfulness and capacity. I do not see how they can do otherwise. Industry and study surely make the road to preferment. When we do not progress as fast as we think we should, more and better work is generally necessary. There is no other way to succeed.

The length of time we have served and the fidelity that has characterized our service will influence (and very properly) our advancement.

A hundred men may start in the railroad service to-day, all on an equality. Ten years' service, and what then? You will no doubt find ten, or less, of them near or at the top round of the ladder. The balance of the hundred will, in all probability, be about where they started or out of a job, quarreling among themselves as to the most deserving or who has been most sadly treated by Dame Fortune. The boys high up on the ladder, who carefully guarded the interest of those they served, who depended upon themselves and their own effort, have nothing to regret. The balance of the gang at the bottom of the ladder, who sought success by an easier and shorter road, will no doubt all agree that they "have a kick coming." Have they?

A little time, my friend, will tell the story. In the meantime, remember that all things come to those who "hustle" while they wait.

The First Train.

When the facetious correspondent of Eastern papers encounters delays on railroad trains in the West or South, he generally tries to get off something more or less funny, with exaggeration as the basis of his wit. The best thing in this line that we have seen was by Bill Nye.

"The first train ever operated," he said, "must have been a grand sight. First came the locomotive, a large Babcock fire-extinguisher on trucks, with a smokestack like a full-blown speaking-tube with a frill around the top; the engineer at his post in a plug hat, with an umbrella over his head and his hands on the throttle, borrowing a chew of tobacco now and then of the farmers who passed him on their way to town. Near him stood the fireman, now and then bringing an armful of wood from the fields through which she passed, and turning the damper in the smokestack every little while so that it would draw. Now and then he would go

forward and put a pork rind on the hot-box, or pound on the cylinder head to warn the people off the track.

"Next comes the tender, loaded with nice white birch wood, an economical style of fuel, because the bark may be easily burned off while the wood itself will remain uninjured.

"Besides the firewood, we find on the tender a barrel of water and a tall blonde jar with wicker work around it, which contains a small sprig of tansy immersed in four gallons of New England rum. This the engineer has brought with him for use in case of accident. He is now engaged in preparing for the accident in advance.

"Next comes the front brakeman in a plug hat about two sizes too large for him. He also wears a long-waisted frock coat with a bustle to it, and a tall shirt collar with a table-spread tie, the ends of which flutter gayly in the morning breeze. As the train pauses at the first station he takes a hammer out of the tool-box and nails on the tire of the fore wheel of the coach. The engineer gets down with a long oil can and puts a little sewing-machine oil on the pitman. He then wipes it off with his sleeve.

"It is now discovered that the rear coach, containing a number of directors and the division superintendent, is missing. The conductor goes to the rear of the last coach and finds that the string by which the directors' car was attached is broken, and that the grade being pretty steep, the directors and one brakeman have no doubt gone back to the starting place.

"But the conductor is cool. He removes his bell-crowned plug hat, and taking out his orders and time-card, he finds that the track is clear, and looking at a large, valuable Waterbury watch presented to him by a widow whose husband was run over and killed by the train, he sees he can still make the next station in time for dinner. He hires a livery team to go back after the directors' coach, and calling 'All aboard!' he swings lightly upon the moving train.

"It is now 10 o'clock, and nineteen weary miles stretch out between him and the dinner station. To add to the horror of the situation, the front brakeman discovers that a very thirsty boy in the emigrant car has been drinking from the water-supply tank on the tender, and there is not enough left to carry the train through. Much time is consumed in filling the barrel again at a spring near the track, but the conductor finds a 'spotter' on the train and gets him to do it. He also induces him to cut some more wood and clean out the ashes.

"The engineer then pulls out a draw-head and begins to make up time. In twenty minutes he has made up an hour's time, though two miles of hoop iron are torn from the track behind him. He sails into the eating station on time, and, while the master mechanic takes several of the coach wheels over to the machine shop to soak, he eats a hurried lunch.

"The brakeman here gets his tin lantern ready for the night run, and fills two of them with red oil, to be used on the rear coach. The fireman puts a fresh bacon rind on the eccentric, stuffs some more cotton batting around the axles, puts a new linch-pin in the hind wheels, sweeps the apple peelings out of the smoking car, and is ready.

"Then comes the conductor with his plug hat full of excursion tickets, orders, passes and time checks; he looks at his Waterbury watch, waves his hand, and calls 'All aboard!' again. It is up grade, however, and for two miles the 'spotter' has to push behind with all his might before the conductor will allow him to get on and ride.

"Thus began the history of a gigantic enterprise, which has grown till it is a comfort, a convenience, a luxury, and yet a necessity.

"You are, indeed, a heartless, soulless corporation, and yet you are very essential in our business."

& Western R.R. Co.

CONDITION OF LOCOMOTIVES.

Month of *189*

IN SERVICE. LOCOMOTIVES IN SHOP.

OF TENDER. Cistern.	Frame and Trucks	General.	Month will Probably Need Repairs.	Estimated Cost of Such Repairs.	Estimated Life of Firebox. YEARS.	Date Entered Shop.	Date will Leave Shop.	Class of Repairs.	REMARKS.

[Fifty lines.]

Total number of locomotives in service, - - - - ..
" " " " shop, - - - -
" " " awaiting repairs, - - ....
" " " on division, - - ....

Total locomotives assigned to division, but running elsewhere, - - - - - - - ......
" " on division, assigned to other divisions, in service, - - - - ....
" " " " " " " shop, - - - - - - ..

All locomotives on the division must be reported, whether assigned to the division or not.

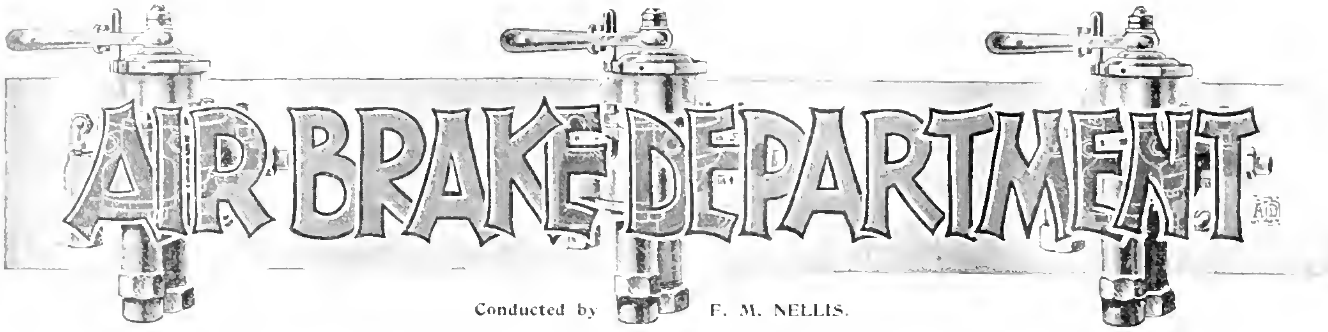
This report must be forwarded to the Sup't of Motive Power on the first day of each month, and MUST BE SIGNED PERSONALLY BY THE MASTER MECHANIC.

Correct, ...

Master Mechanic.

⁂ ⁂ ⁂

On October 20th, the Monon Route put on a new fast train for Atlanta and the South. Train leaves Chicago 10:15 A. M.; arrives Louisville, 7:39 P. M.; Nashville, 2:15 A. M.; Chattanooga, 7:10 A. M.; Atlanta, 11:15 A. M., making the run from Chicago to Atlanta in twenty-five hours. Returning, the train leaves Atlanta 3 P. M., arriving Chicago 5:30 P. M.



Conducted by F. M. NELLIS.

Combination Angle Cock and Warning Signal.

Patent angle cocks, which apply brakes or give warning when closed, are becoming quite numerous, and unless the automatic car coupler patentee looks closely to his laurels he will find himself severely jostled by this erstwhile inventor crowding into first place. The latest addition to the already large family of angle cocks, herewith illustrated, is the product of Mr. William Bedell, of Jackson, Mich. The operation of the device is as follows:

When the valve is open, so that the brakes can be governed by the engineer, the holes D_2 and E_2 are covered by the bushing G, so that no air escapes to the whistle; but when the plug is turned, so as to partially or entirely shut off the air in the main pipes, the holes D_2 and E_2 come into the opening g, which extends through the bushing G. When in this position the air passes through the holes D_2 and E_2, down through the cavities or spaces D and E, and from there out through their respective openings D_1 and E_1. Now, in the bushing G are the grooves G_1 and G_2, leading to the holes corresponding to those marked D_1 and E_1 in Fig. 3. This allows the air to pass through the openings in the bushing before the holes in the plug and the corresponding ones in the bushing come directly opposite each other. This is so that the alarm will begin to sound before the air is entirely shut off from the brakes. The air, after passing through the holes D_1 and E_1, passes into the holes H and I1, and raises the valves H_1 and I_1, and then to the pipe B_1 and to the alarm, thus warning the trainmen that the valve is being meddled with, and at the same time definitely locating which one it is, as each valve has its own alarm. The valves H_1 I_1 serve to prevent the air backing up in case the pressure comes from only one side.

When switching or any other cause requires the hose to be parted, and it is not desired that the brakes shall set, the small cock under the whistle should be closed to prevent the escape of pressure.

(Waiving the discussion of whether such angle cocks are real necessities, we would say the same for this device that has been said of others, namely: That it would undoubtedly accomplish the purpose for which it was designed. When compared with others of its kind, however, the complication of parts becomes conspicuous, and would seem to suggest seeking a favorite from amongst others of simpler construction. The gage and whistle, with which each cock is equipped, would grate harshly on the nerves and offend the sight of the hard-shell air brake practitioner, whom experience has taught that one of the prime factors of the success of any appliance is its utmost simplicity.—Ed.)

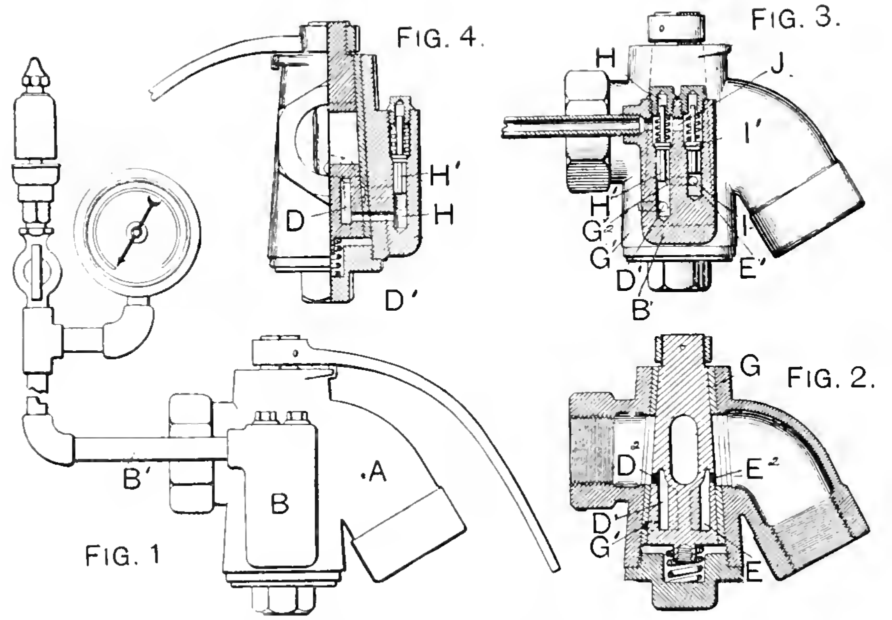


FIG. 1 FIG. 2. FIG. 3. FIG. 4.

Train Pipe Angle Cocks Working Shut.

An important case of a train pipe angle cock closing from coming in contact with a loose deadwood on a freight car has been recently traced by G. W. Rhodes, superintendent of motive power of the Chicago, Burlington & Quincy Ry., and the facts developed leave no room for doubt that there is considerable cause for anxiety to be apprehended from this source. A loose deadwood thrusting against the key of the cock renders the handle quite easily turned. A loosely attached train pipe, shaking about when train is in motion, is liable to strike in a glancing manner against the deadwood or other part of the car and cause the handle to turn around in much the same manner as a nut on a bolt is sometimes loosened with a hammer by a workman. The subject of angle cocks becoming thus closed has been but lightly touched upon in past discussions on air brakes, but the development of facts in Mr. Rhodes' investigation calls for grave consideration, to which the subject is entitled, and demands that due care be exercised in locating the cock at a safe distance from the deadwood and other points of interference, and to also see that the train pipe is rigidly attached to the car body as it should be.

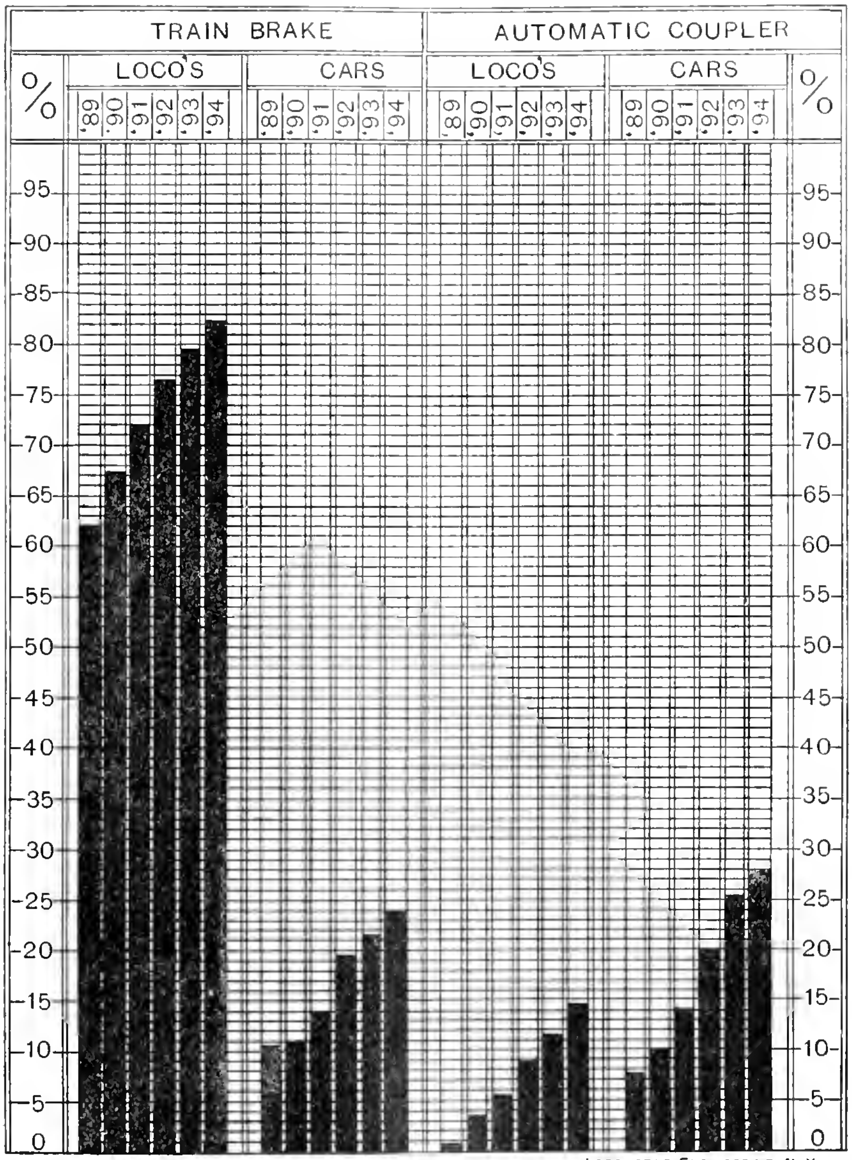
Better Brakes Coming.

That the air brake's cause is improving is evidenced by the appointment of a committee by the Master Car Builders to investigate and report upon the subject of "Location of Air Brake Cylinders on Freight Cars," with a view of affording easier means of access for cleaning and repairing. Simultaneous with this the Air Brake Men's Association has taken up the subject of "Economical Oiling of Brake Cylinders." This would seem to indicate a promise that better brakes may be expected, and is of considerable significance to air brake men who for some time past have realized that the brake cylinder and its atachments are the most neglected portions of the air brake system. Hitherto little, if any, attention has been given to the location of the cylinder, and the care of its parts consisted of an occasional injection of poor oil and prominent chalk marks on the outside of the cylinder giving the date of the dose. Frequently the former part of the process was intentionally omitted. The Air Brake Men be-

lieve one good cleaning and oiling better than several injections at the oil hole. The M. C. B. believe in placing the cylinder where it can be reached to do the work.

Statistics of the Interstate Commerce Commission on Safety Appliances.

The accompanying diagram, taken from the report of the Interstate Commerce Commission for the year endin June 30, 1894, is a graphic illustration of the proportion of locomotives and cars in the



United States at present equipped with air brakes and automatic couplers. The black lines of the diagram show the proportion of equipment fitted with brakes and couplers, and the white portion shows the proportion not yet supplied.

The record of equipment fitted with these safety devices as shown in the diagram ended a year ago last June, leaving sixteen months unaccounted for; yet, in making due allowance for this interval of time, in which there has been an increased activity in locomotive and car building over that of the few preceding years, it is evident that railways will be obliged to hustle more in the future than they have in the past if they expect to comply with the law which requires all equipment to be fitted with train brakes and automatic couplers by January, 1898.

If a man carries a watch and neglects to properly wind it, he is as liable to miss a train as a man who carries no watch. A car whose air brake has become inoperative through neglect, is as friendless as a car without a brake.

Frost and snow are already here, and the consequent flat wheel epidemic may be expected any day. Prepare to resist the attacks of this costly disease by studying the cause and preventatives as prescribed by the Air Brake Men in their second annual proceedings.

Give especial attention to draining the main reservoir during the cold weather, as such care will save many disagreeable jobs of thawing out triples and reducing valves.

CORRESPONDENCE.

A Mountain Service Encomium for the Continuous Driver Brake.

Editors :

I write you to concur in your editorial criticisms of the device shown in your October issue of "Locomotive Engineering," page 641, purporting to be a protection against loose and flattened tires of locomotives; and by way of information I will add that we use the continuous automatic driver brake on our locomotives here, both over the Raton and Glorieta mountains, on grades 156 to 190 feet to the mile. The same has worked satisfactorily since I have had charge of this division, which is about four years past, with the possible exception of one instance, which ocurred quite recently, wherein a certain locomotive engineer, either through ignorance of the manner of handling air or through his general indifference as to the performance of his duties, heated and loosened a set of 4-inch tire, coming from Raton Tunnel down to Raton—a distance of seven miles—when he only had engine and caboose to handle. The tires were moved, closing the gage almost 2 inches, and the man left his engine, going home, and did not know it.

W. E. SYMONS,
Raton, N. M. Div. Master Mechanic.

Regarding Question No. 22.

Editors :

In October number of "Locomotive Engineering" I see a letter from Burnside signed by C. M., asking if a leak in pipe between triple valve and brake cylinder will cause brake to release with valve handle on lap after a ten pound reduction, and you answer that it will not. Now in this case C. M. has not given details as he should have done, and his question is very misleading. I have examined the engine that C. M. has been running and found that this leak was the sole cause of brake releasing after a ten pound reduction and valve handle had been returned to lap position.

In the first place, the engine and tender in question is equipped with a "freak" brake apparatus, namely, a 12x33-in. auxiliary reservoir and 8-in. brake cylinder. I have made a test with an engine having air brakes the exact counterpart of this engine, and find that with a 6-in. piston travel a ten pound reduction in the train pipe pressure (our standard is 65 pounds) will apply the brakes full at 56½ pounds, and brings the train pipe a pound and a half below the equalized pressures of the auxiliary reservoir and brake cylinder, which insures the full travel of the triple valve piston and slide valve. Now, a leak in pipe between triple valve and brake cylinder reduces auxiliary reservoir pressure along with brake cylinder pressure, and as soon as these pressures are reduced below train line pressure the triple goes to the release position, allowing the re-

maining air in the cylinder to whistle out through the exhaust port. C. M.'s friend was right when he told him that this leak caused brake to release. C. M. seems not to have considered that it made any difference whether he had a main reservoir or the proper size 10x24-in. for an auxiliary for his 8-in. brake cylinder. A. H.

Chicago, Ill.

(The answer given to C. M.'s question No. 22 in October issue will stand unchanged, as it is the proper prescription for the case as diagnosed by him. The additional data furnished by our correspondent, however, is a diagnosis of a somewhat different character, and requires a correspondingly different prescription. In order that matters may not become mixed, we will treat this as a separate and distinct case.

With proper brake equipment, a ten pound reduction in train pipe pressure will only partially apply the brake, causing the slide valve to stand with its graduating port in register with the cylinder port, after an equalization is had in pressures in the auxiliary reservoir and train pipe, and further flow of pressure from the reservoir to the cylinder will be temporarily cut off by the graduating valve seating in the graduating port of slide valve, by the slight movement of triple piston toward release position. If the graduating valve and slide valve are absolutely tight, no further pressure will pass from the reservoir to the cylinder, and a leak in the cylinder pressure would not affect the movement of the triple, no matter how large the auxiliary reservoir may be. But with cylinder and auxiliary of dimensions given by our correspondent the case is somewhat changed, for, as he says, a ten pound reduction in train pipe pressure will apply the brake fully, and place the slide valve in extreme lower position, thus establishing direct communication between the reservoir and cylinder. A leak in the cylinder pressure will now draw on the reservoir as well, and allow the triple piston and its attachments to move towards the release position. But if the slide valve and the graduating valve are absolutely tight, the piston will stop on the lap position, providing the parts have not sufficient frictional resistance, which, when broken, would cause a momentum that would carry the piston to full release position. Summing up, we can say that if the slide valve and graduating valve are perfectly tight, the piston and slide valve will stop on lap position if not interfered with by undue frictional resistance, and also that the momentum of the parts caused by breaking away from frictional resistance, and the combination of leaky graduating and slide valves, or a leaky slide valve alone, will cause it to travel past the lap position and continue on to full release. Any of these latter discrepancies, when in combination with a leakage in cylinder pressure, will cause the brake to whistle off through the exhaust port, but the leak of itself will not do it as previously stated in question No. 22. While a careful examination has failed to reveal it, it is altogether possible that a leakage exists in either the slide valve or graduating valve; for in service it is almost equally difficult to make an absolutely air tight fit as it is to secure a perfect vacuum. The 12x33-in. auxiliary reservoir should be exchanged for a 10x24-in.—Ed.)

An Air Pump Repair Stand.

Editors:

Did you ever "rassel" with an old air pump on the floor? Hard job, is it not? Well, I propose to get the pumps off the floor, and ditto the bench, by a scheme as follows:

Get an old 20-inch solid head piston, face off the front face so it will rest evenly

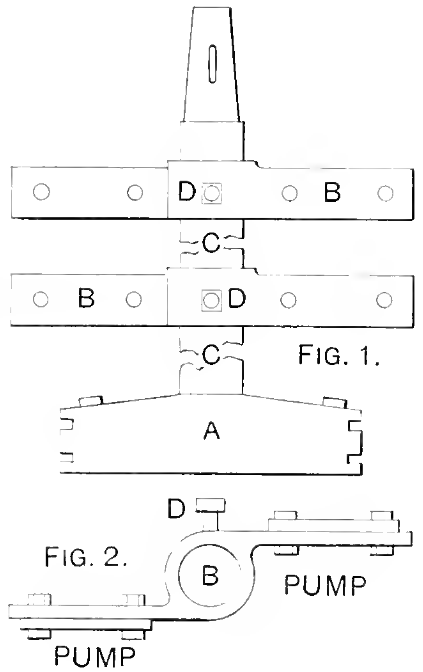


FIG. 1.

FIG. 2.

on the floor, as shown in the sketch, and drill three or four holes for holding down bolts. True up the rod to whatever size it will make. Make two forgings like B, B, Figs. 1 and 2. Bore a hole through the boss so it will be an easy fit on the piston rod. Make two thimbles of gas pipe as per C, C, making them the proper length to slip over the pison rod, as shown. Drill, tap and fit set screws in boss of arm B. Make the set screws pointed, and drill into the rod on two opposite sides, pockets to receive the points of set screws. The pockets for the set screws should be drilled, so that when the screws are set up the faces of the arms are exactly in line. After we repair one pump we want to give the thing a half turn and put on another. Fig. 2 shows how the pumps should be bolted on.

I don't know why it would not be a good addition to a testing plant. We could hang up two pumps, and after testing one, swing it around and couple up the other; and by leaving the tested pump hang it would balance the other one, and lessen the jar of the running pump.

In some shops, where testing plants are installed, there seems to be a mania for placing the pump in a dark corner or close to the wall, where there is no light or room to work. This scheme gives plenty of room and light.

W. DE SANNO,

Indianapolis, Ind. Pan Handle Shops.

Conger's Problem, Illustrating "Stuck" Brakes.

Editors:

In our air brake schools, as we do not have an instruction car, we use an engine with driver and tender brake coupled to a coach with a quick-action brake, and put gages on the coach triple, so the class can see just exactly how the brake works. This is a fairly good substitute for an instruction car, if it is a pleasant day.

The other day we used an engine with an 8-in. spread brake having 3 inches piston travel, an 8-inch tender brake with 7 inches piston travel, and a coach with 8 inches piston travel. When we set these brakes with a full service application—reducing train pipe pressure from 70 to 50 pounds—the coach brake would release first, while with an emergency application the driver brake would release first, the tender brake next, and coach brake last, and as the brakes were all in first-class order it would release in that order every time we tried it. In each case the brakes were released by placing the brake valve—a D 8—in running position, so train line would charge up gradually; as soon as the first brake was released, valve was lapped and other brakes could be held at the pleasure of the operator.

Now why this difference in the way the different brakes released with emergency and full service applications?

C. B. CONGER.

Grand Rapids, Mich.

A Primitive Air Signal.

Editors:

Being a regular reader of "Locomotive Engineering," and seeing that you are encouraging all kinds of designs, I herewith send to you a little design of my own. which I have put in use on the engine I am running here on the E. & I. R. R., in place of the signal bell, which we have had so much trouble with. It is a small whistle to be blown by air and used by the bell cord now in use. Its cheapness, where it is now practiced, commends it to all.

It blows quite readily to full pressure of drum, and never fails; the open ring 8 is put there in case the engine should break loose from train, which would open and release bell cord.

It is very sensitive to the touch, and readily responds to the cord. It can be put on in a short time without any change to cars, needs no piping on air hose or

any other work to use it. Following is a description by numbers:

No. 1. Main air pipe from pump to drum.

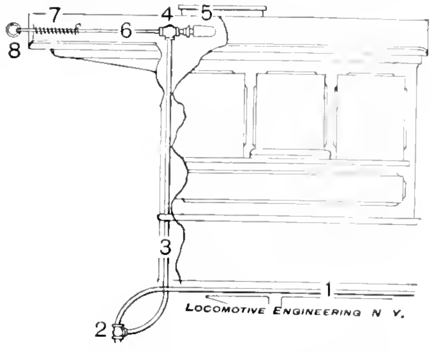
No. 2. ¾ T, with side opening for ¼ pipe.

No. 3. ¼ pipe to valve.

No. 4. ¼ T valve with threads off stem, and a spring slipped over to insure its close.

No. 5. Whistle.

No. 6. ⅛ pipe leading from valve stem to outside of cab.



No. 7. Spring 5 in. long, held to cross piece of cab by cotter pin through pipe for cushion.

No. 8. Open spring ring for safety.

GEO. J. PAYTON.

Evansville, Ind.

(This design of air signal was among the first introduced in train service, but on account of it retaining all of the objectionable features of the continuous signaling cord, it was abandoned in favor of the automatic form.—Ed.)

Continuous Driver Brakes on Heavy Grades in the Black Hills.

Editors:

Having seen considerable correspondence in your paper relative to continuous and independent driver brakes, and having read your remarks (with which I entirely concur), I wish to say that our experience on the Black Hills division of the Burlington is this: That an independent brake on drivers is neglected at the moment of imminent danger.

During an experience of nearly five years on three or four per cent. grades, we have tried all forms of driver brakes. We first tried the continuous automatic, as perfect in all respects as we could make them, with very unsatisfactory results. Our next was the cut out kind, and we found on nearly every occasion when this was wanted in cases of emergency it had not been cut in, and was not available for use. With the independent form the coaches were obliged to do their own holding as well as that of the engine, and driver brake was never used except at odd times. This led to the abandonment of independent driver brakes, and we now use the continuous form, so adjusted that they gradually leak off, and on a slippery rail in the fall and spring we are enabled to use the only auxiliary, the water brake. A bad rail now has no terror for our crews, and our trains are handled over the mountains so certainly and easily that we never concern ourselves about it at all. While the driver brake is made slowly to leak off, and does not do all the work it is capable of, yet it greatly helps out the train brakes and makes the work lighter for all by dividing up the work more evenly.

If any of the advocates of independent driving brakes do not believe that the continuous brake can be advantageously worked on their mountain mole hills, we would invite them to come and see a train that travels 214 miles a day over the mountains, and which can boast of having only two failures in two years, and has never run by a station a train length in the last three years. Nor have we had a runaway on freight to our regular crews for three years and two months. Some of your readers who are followers of the independent brake may not agree with me, but the proof of the pudding is the eating. Success follows the practice.

GEO. SMART,
Edgemont, S. D. General Foreman.

(While we are for the unmodified continuous form of driving brake, yet we must congratulate the road represented by our correspondent upon the achievement of a success, and hope that the gradual leakage described may later be dispensed with, thereby attaining the highest perfection of continuous train braking. It is pleasing to note that after fruitless excursions into experimental fields, we finally return to the continuous as the safest and best form of driver brake for all classes of level and ordinary mountain road service.—Ed.)

A Well-Designed Brake for Tenders.

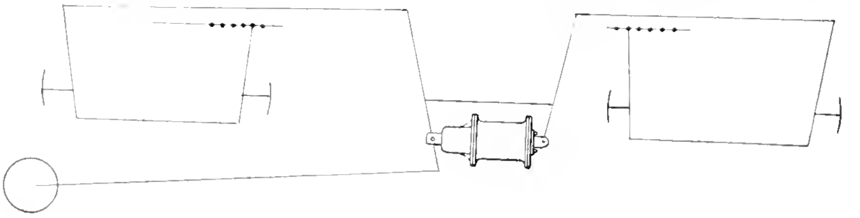
Editors:

To those interested in air brakes it is often a matter of surprise to observe the many different forms of brake gear employed on tenders. Some are fantastic in design, and so arranged that no formula is at hand to determine what force is exerted on the beams; frequently they are found with no equalizing feature, but so arranged that with every renewal of brake shoes the force is exerted on the beams on one truck of the tender only. Proper braking force, in very many instances, seems not to have been considered, while the beams, levers, etc., are not of a proper size to avoid deflection. No apparent attempt has been made towards having a standard gear, and as a result a minimum of expense has not been realized in maintenance.

For several years the writer has advocated the Stevens system, slightly modified, for tenders, and its long continued use has demonstrated that for cheapness in maintenance and efficiency it has proven equal, to say the least, to the best designed tender brakes. It is not the purpose of this article to discuss the numerous defects of the average tender brake, but rather to suggest the use of a design that is quite able to fill all the requirements for which a power brake is intended.

The sketch shown will give an idea of a Stevens brake gear adapted for tenders.

With this arrangement it is usually possible to use one standard length over all for cylinder, live and dead levers, the only departure therefrom being the location of the intermediate or tie rod holes in cylinder levers to give the requisite braking force. Even this may be somewhat simplified by classifying the tenders by weight, say three classes, and locating the tie rod holes accordingly. With this arrangement of brake gear and the employment of M. C. B. standard sizes of levers, jaws, rods, pins, etc., and beams of requisite strength to resist deflection and the brake force adapted to 90 per cent., or better still, 100 per cent. of light weight of tender, a model tender brake is secured.



S. J. KIDDER.

Chicago, Ill.

Independent Driving Brakes.

Editors:

Having read and considered the various articles published under this head, and drawn some inspiration from that mystic and awe-inspiring word, "experience," the following opinion on the subject is submitted:

The independent driver brake ever meets with favor by the engineer of faulty judgment, for, as he says, "It makes it easy to add to or let off a little power just as you want," an ever present want with that class whenever the brake is used. It is also favored by many good engineers who exercise judgment in doing their braking, because, if properly handled, it is a valuable assistance to them. The writer is a believer in an easily varied brake power for descending grades, as it undoubtedly permits of a more uniform speed being maintained, is an air saver, and gives a greater degree of safety to the train. On the other hand he is not a believer in the independent driver brake to accomplish this.

Here we will draw on "facts" that are developed by individual experience alone. It was the latter, we are told, which caused one of the "Six Blind Men of Hindostan" who went to see the elephant, to declare on getting hold of the tail, that the animal was "very like a rope."

An investigation of many instances where driving wheel tires have been loosened by the brake has determined that in the majority of these it was with the independent form. The reason is because there is nothing to prevent the engineer from using too heavy an application or continuing it too long; where, with the continuous form, danger can be guarded against by the proper adjustment of piston travel, and the restricting influence exercised by the train brakes.

A wrong impression seems to exist as to the relative efficiency of the retaining valves and the independent brake. The retaining valves on thirty cars should exert considerably more retardation than the driver brake on any of the heavy mountain engines. If there are any whose "experience" seems to contradict this, let them not be too hasty in saying so, but, instead, seek out the true cause and agitate its elimination.

The brake favored for service where the grade is heavy and the maximum speed slow, is the Le Chatelier or water brake, as recommended in last month's issue, and also, by the Air Brake Association in their proceedings of 1894 and 1895. The price of these proceedings has been brought within the means of all, and it is scarcely excusable for any man professing interest in brake matters to fail to procure them, or, in discussions, ignore consideration of their contents.

Believing that those taking part in this discussion are in possession of these proceedings, the recommendations and arguments they contain are submitted in support of the stand taken by the writer.

St. Paul, Minn. F. B. FARMER.

(As there was but a limited number of copies printed, it is hardly probable that nearly all readers of "Locomotive Engineering" are supplied; and in order that all may know how the independent driver brake stands with this authoritative organization, whose membership includes a considerable number of locomotive engineers in both level and mountain road service, the extract on driver brakes from page 154 of the Second Annual Report of the Air Brake Men's Proceedings, under the caption of "Continuous vs. Independent," appears elsewhere in this number.—Ed.)

Independent Driver Brakes.

Except for very long and exceedingly heavy grades there are now heard but few advocates of the independent brake. The use of the brake in the continuous form is now so general on level roads as to refute all claims of impracticability. The arguments in favor of the last mentioned form are: First, by being operated by the same valve as the train brakes, it is never forgotten in the emergencies, whereas with the other form it is almost always overlooked at such times. Second, its use will thus be made frequent, and defects rendering it inoperative would be noted much quicker. Third, where properly adjusted, it cannot cause loosening of tires, nor, on the other hand, be left unused, compelling the train brakes to do a greater amount of work. Fourth, it has none of the following objectionable features of the independent form, viz.: Where used as straight air, drawing on the pressure needed for recharging the train and being liable to brake too high or too low, dependent on amount of pressure in main reservoir. Where steam or vacuum furnishes the power, there are the extra parts to operate and maintain.

Some insist that the driver brake should be retained as a reserve power to fall back on in emergency where train brakes are either partly or fully applied. It should occur to such that if their driver brakes were continuous their use would relieve the train brakes of so much work that the same amount of reserve power would be distributed throughout the train where it would be most available and could be applied with the least possibility of damage resulting. Besides this there would be much time saved through having but one valve to operate.

Of all the disagreeable neck-kinking jerks, those resulting from the use of this "reserve power" when nearing a stop with an eight or ten car passenger train is beyond question the worst.

The only one approaching it is when with same kind of train and brakes lightly applied, or not at all, the engine is reversed and "plugged" (steam used).

Another argument is that these brakes can be used to assist the train brakes in holding on a down grade. They undoubtedly can be, but even discipline has not resulted in their always being so used. Then, too, when it is not possible for the good engineer to properly apportion the holding power of the driver to that of the train brakes, when the former are independent, what can be expected of the mediocre ones, to say nothing of the poorer class?

Were there gages showing the pressure in driver and car brake cylinders it would even then require constant manipulations of the driver brake valve to accomplish the desired result.

With the continuous brake we depend on nothing but the correct adjustment of piston travel on engine and train brakes, and the proper distribution of work is sure to be had even though the engineer handles the brakes indifferently.

Some very good arguments have been put forth in favor of the independent brake, such as, when stopping for a water tank or switch, when pulling out of a siding and slowing up for brakemen to

The sales of Gold Straight Port Steam Couplings have averaged over 500 per day for the past month.

The Gold Car Heating Co.

This Coupler has a brass-faced seat, steam-tight always. No trouble, no replacements.

Frankfort and Cliff Streets, New York.

get on after switch is turned, the ease with which train can be held bunched while train brakes are released, or the lesser amount of air needed to accomplish the last mentioned. But the fact is lost sight of that in view of the disadvantages of this brake, before mentioned, the gain is not commensurate with the loss.

The idea expressed by some correspondents of one of the railway journals that the continuous driver brake will, during brake applications on grades, cause bunching of a long freight train, is, generally speaking, erroneous. If any engineer has had this experience we would advise that the driver brake pistons be made to travel a little farther, thus avoiding the possibility of overheated and loose tires. Driver brakes do not hold anywhere near as much as retaining valves on a forty-five car freight train. If such should occur so, it would speak volumes for the need of more attention being given the train brakes. Good doctors locate and try to cure the disease.

It is not desirable, in holding down grades, to have the driver brakes do quite as much work as the train brakes, but, instead, to do a certain proportion of the holding, and to have their full power available instantly when needed.

An independent brake is very useful in assisting to maintain a uniform speed when recharging, but another means, equally as good, and almost always available, and made use of by the good engineer, is to recharge where "let ups" (lesser grade) or curves would otherwise tend to slow down the train, and where retaining valves are most efficient.

Where it is advisable to use a retarding force on the drivers during such time, or fear of tire heating, if brakes were used continuously, exists, the best solution of the question is to place a cut-out cock in pipe leading from triple valve to brake cylinders, have its handle so arranged that engineer can operate it from cab seat, equip engine with the "Le Chatelier" counter pressure or water brake, as it is commonly known, and to use the latter.

It can be operated continuously in descending grades and driver brakes be cut out, or, instead, only at the time of recharging, the driver brake being cut out then but operative at all other times. By this means all the advantages of an independent brake are had, the tires are allowed to cool off and yet the full benefit of the continuous brake is obtained.

Watch the piston travel and see that all cars have a stroke of about 7 inches. Don't think that by looking at the distance the brake shoes hang off the wheel you can tell the piston travel, for you can't any more than you can by looking at a cat tell how far it can jump. The braking power given to the car governs the shoe clearance. Watch the piston.

We are informed that the Hutchins & Skinner Safety Angle Cock is giving excellent results in trial tests on several prominent railroads.

Switch all air braked cars ahead, and keep them coupled up and working, for they may prove your salvation some day when least expected. Remember the story of the Texan and his gun. He didn't need it often, but when he did, he wanted it mighty badly.

The use of the columns of this department is free to those desiring to impart or obtain air brake information, and we therefore cannot comply with the request of those writers who desire a private correspondence. Correspondents will please give full name and address. Let all description be full and complete.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(31) J. E. W., Topeka, Kan., writes:

I would like to find out the cause of the following difficulty with air pump or governor, and which is out of order. Pump would pump up all right to 70 and 90 pounds and stop, but would not go to work again until pressure was reduced 48 pounds. I tried three different governors with the same result. Then tried each of these governors on other pumps, and they worked all right without repairs. We also went through the pump and found nothing the matter with it. Please give your opinion through the columns of "Locomotive Engineering" and oblige a reader. A.—As the three governors worked all right on other pumps, and the pump in question was examined and found to be all right also, proves there was nothing wrong with either governors or pump. The trouble must, therefore, lie in the air pipe to the governor, which was probably partially stopped up or was wrongly connected.

(32) R. E. L., Chicago, Ill., writes:

I have a plate E6 brake valve on my engine. When I throw the handle to emergency and quickly bring it back to lap position, the brakes on my engine and tender both apply, but they whistle off through triple almost immediately. If I leave the handle in emergency the brakes stay on. What causes this? Is it possible that a surge of air in the train pipe of light engine makes it? A.—The length of train pipe on your engine and tender is too short to produce a surge. When returning your brake valve handle to lap quickly after making an emergency application, the pressure in your equalizing reservoir, which remains unused at its maximum, leaks past the packing ring of the equalizing piston, and is sufficient to raise train pipe pressure above that in the auxiliaries, and force the triples to full release. Watch the black pointer of your gage, and notice if it drops down from its full pressure.

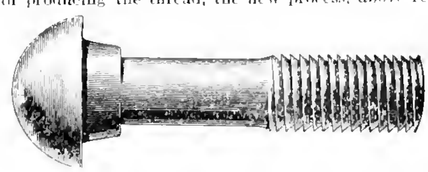
(33) J. J. M., Hazleton, Pa., asks:

In what position should the brake valve handle be placed on the second engine when running double? In what position should the train cocks be in? Is it necessary that the second engineer should release his brake when the first engineer

CONCERNING RAILWAY TRACK BOLTS.

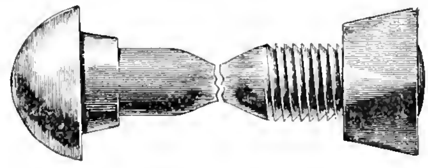
IN the evolution of the modern railway, not the least important member of the permanent way is the bolt that binds the angle bars and rails together at the rail joints. Way back in the forties and fifties, when iron rails, weighing about fifty-six pounds to the yard, were generally used, the splice bolts used for this purpose were an ordinary 3-4 inch diameter iron bolt with a more or less imperfectly fitted nut. Since that time heavy steel rails weighing nearly 100 pounds to the yard have taken the place of the old light iron rails, and locomotives and cars twice or three times as heavy as those formerly used have been substituted, and yet on most roads the same old-fashioned 3-4 inch diameter iron cut thread bolts are still in general use. It is not surprising, therefore, that with our modern heavily loaded trains running at greatly increased speed, that disastrous railway wrecks frequently occur, the cause of which is not always easily ascertained, but it may reasonably be inferred that in many cases the splice bolts were too weak to sustain the lateral thrust, and as a result the rails parted at the joints, allowing the cars to leave the track. The iron cut thread bolt will not stretch more than about 1-8 inch before it snaps off short at the root of the thread, and unless all of the four bolts fastening a joint are screwed up uniformly tight so that each one sustains its proportion of the strain, one after another of the bolts will successively give way, resulting in serious disaster. On most English and Continental roads the custom at present is to use bolts 1 inch in diameter, and a few roads in our country are using bolts 7-8 inch in diameter.

Messrs. J. H. Sternbergh & Son, of Reading, Pa., well-known manufacturers of Bolts, Nuts, Rivets, etc., have lately effected an improvement in Railway Track Bolts by the substitution of soft steel for iron, and a novel method of producing the thread by a sort of cold-rolling process, by which the metal on the surface of the bolt is spun up into the form of a thread, rather than by the common method of cutting the metal out with a die to form the thread. It is well known that this common method of cutting the thread weakens the bolt very greatly, and in the case of a 3-4 inch diameter bolt, so much of the metal is cut away by the die that the diameter of the bolt at the root of the thread is reduced to about 5-8 inch, which, under tensile strain, will ordinarily break off short at a pressure of about 17,000 pounds. In distinction from this faulty method of producing the thread, the new process, above re-

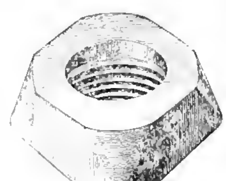


ferred to, produces a perfect thread by cold pressure, which results in increasing instead of reducing the strength of the bolt, so that a bolt 3-4 inch in diameter in the shank will be 13-16 inch in the threaded portion, substantially as shown in the cut above.

Under tensile strain these bolts will stretch about 5-8 inch before breaking, and when they break (if they break at all), they will not break in the threaded portion, *but in the blank portion of the bolt.* (See cut.)



Thus it will be observed that in a joint of four or six bolts, even if each bolt is not screwed up as tightly as the others, they will stretch under tensile strain until all the bolts sustain their equal share of the lateral thrust, thus obviating the danger before alluded to, of the rails parting at the joint and derailing the train.



In addition to these improvements of the bolt, the Messrs. Sternbergh & Son have made important improvements in the nuts, by which the corners of a square nut are chamfered substantially as shown in the cut, adapting them for use on angle bars, in place of the more expensive hexagon nut, and with better advantage, because of their increased wrench hold.

Another important feature is the recess, shown in the cut, formed on the bearing side of the nut, a little greater in diameter than the threaded portion of the bolt, and deep enough to house and protect two of the bolt threads from injury by the chafing of the angle plates in service, and admitting of two perfect threads at least on which to tighten up the nut, when from wear or other cause the nut needs tightening. In addition to this form of nut, the above firm are in the habit of cutting the threads in the nut of such form and pitch that when screwed home upon the bolt it will stay in position and not work loose, especially when the bolt thread is made in the form illustrated, called the "Harvey Grip" form of thread.

The improved bolt and nut, which are patented articles, represent the highest point of perfection yet reached in the evolution of the Railway Track Bolt, consisting of only two parts, complete, requiring no nut locks, washers, or other devices for holding the nut in position, and they will be found to be as much better than the ordinary iron cut thread bolt, as the heavy modern steel rail is superior to the old-fashioned iron rail.

THESE BOLTS AND NUTS ARE MANUFACTURED EXCLUSIVELY BY

J. H. Sternbergh & Son, Reading, Pa.

AND

Kansas City Bolt and Nut Co., Kansas City, Mo.

does? Does the pressure on second engine's gage show the same pressure as on the first engine? A.—Where no cut out cock below the brake valve is provided, both D8 and E6 brake valves should be placed on lap, and pump throttled so that a moderately high main drum pressure be maintained in event of necessity. Where the cut out cock is provided, as it should be on all engines, the valve handle should be placed on running position. 2. Cut out cock under brake valve on second engine and train pipe angle cocks on front end of first engine and rear end of last car should be closed; all other cocks open. 3. No. 4. With cut-out cock under brake valve closed on second engine, both engine gages show their individual pressures.

(34) W. R. B., Newark, N. J., writes:

I hold that it is better for the pump to work slowly, as the maximum air pressure is reached, rather than to "race" to get up the pressure, and then stop until the pressure is reduced, and then again "race." Am I right? In your answer will you please give reasons. A.—The demands of air brake service require that a successful air pump governor shall offer no interference whatever until the maximum pressure has been reached, and then must perform its duty quickly. It must be sensitive to slight reductions in pressure, and quickly resupply that which has been lost by leakage or in use. While it is poor judgment to unnecessarily race a pump, still there are times when fast work is required. It would be a very unwise and unpopular scheme to place a device in the dome of an engine to restrict the passage of steam to the cylinders for fear that the engineer would work the engine too hard or run too fast. Locomotives and air pumps are alike in this respect; sometimes they must be worked hard, and at other times lightly, and all according to the requirements of service, which shall be left to the discretion of the engineer.

(35) J. C. H., Waldo, Texas, writes:

My driver brake is working in a manner which I do not understand. In making a service application the driver brake will set, but as soon as the handle of brake valve is moved back on lap position, it will release. If emergency application is made brakes will stay on as long as I leave the handle in emergency position. The driver brake will set and release with handle in running position. I have the new improved brake valve with the excess pressure valve attachment, instead of the train pipe governor, and my pump governor is attached to the train line. A.—If your driver brake whistles off through the exhaust port, it is quite probable a leaky rotary valve is the cause of it. Test it as per instructions given in answer to question No. 22, in October issue. Also look for leaks in your auxiliary reservoir pressure. Your description hardly suggests a leaky packing leather. The setting and release of the driver brake when handle is placed in running position is probably due to the valve being left in full release too long before being returned to running position, thereby allowing small train pipe leaks, or unequal feeding of tender and driving brake auxiliaries to make a reduction during the interim in which your pump is accumulating its excess pressure. Possibly your high main drum pressure is thrown into the train pipe and equalizes above governor pressure, with the same result as described in answer to question No. 22.

(36) T. C. M., Seattle, Wash., asks:

With a quick-action triple valve can you get quick action after making a 5 pound reduction, without first releasing and recharging? A.—With auxiliary reservoir the train pipe pressures at the maximum of 70 pounds, the brake cylinder empty, and piston travel adjusted at 7 inches, about 20 per cent. increase in cylinder pressure is had from a quick-action application over that obtained by a full service. With pressure in the cylinder, and the train pipe and auxiliary pressures reduced below the maximum, the percentage of increase falls off, owing to the increased resistance with which the cylinder pressure opposes the entrance of the weakened train pipe pressure. When a certain stage is reached the resistance of the cylinder pressure is greater than the force of the train pipe pressure, and quick action disappears. Piston travel and condition of the triple valve control the point at which it is impossible to get increased cylinder pressure from a quick action application. At the M. C. B. rack test of air brakes, held at Altoona, November, 1893, train pipe pressure was obtained in the cylinder by an emergency application after thirty pounds had been admitted by a service application. Should the brakes be partly applied, and it is desired to stop as soon as possible, throw brake-valve handle immediately to emergency position regardless of how hard brakes are applied at the time. The stop will be longer if an attempt is made to recharge, and then get quick action.

To the South.

Commencing November 1st, winter excursion tickets to Florida, Cuba, Aiken, Columbia and Charleston, S. C., Augusta, Savannah, Thomasville and Brunswick, Ga., will be put on sale by the Atlantic Coast Line, in connection with the Pennsylvania Railroad. This is the only line from the East via Richmond, and is the shortest route to Aiken, Augusta and Middle Georgia. Next in order of coming events in the South will be the re-establishment of the solid vestibule trains known as the "New York & Florida Special." This service was inaugurated by the Atlantic Coast Line in 1888, and has been in effect every season since between New York and St. Augustine. Apply for full information to Georgia & Eastern office, 229 Broadway, New York.

To Better the Condition of Railroad Men.

At the annual meeting of the Northwestern Railroad Club, Mr. George Royal, of the Nathan Mfg. Co., delivered a most interesting address on "Conditions and How to Better Them." His theme was one which has been a life-long hobby with him—that of helping to make the condition of railroad men better. He outlined at some length the rapid development of our system of transportation, and the new social conditions which that had developed. Suggestions were made for bringing the officers of railroads into closer community with the mass of employés. This would undoubtedly result in the growth of loyalty among those who stand the heat and burden of the day in carrying out our great transportation business. The most useful organ for bettering the condition of railroad men was considered the railroad department of the Young Men's Christian Association. It is only twenty-four years since the first of these branches was organized, but there are now about 100 of them, with a membership of 20,500. About 75 per cent. of the cost of managing these establishments is paid by the railroad companies, and it is one of the best investments they make. We regret that want of space prevents us from publishing Mr. Royal's address in full.

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IN THE FOLLOWING AT A PRICE?

Metropolitan Injectors.

Two—new—in perfect condition, with valves, fittings, etc.

No. 8 Sturtevant Blower.

New—perfect condition (noiseless), all attachments, including countershafting.

Foster Air Pump.

No. 2 Steam Air Pump for air pressure —new and in perfect order.

No. B4½ Pump.

For cold water; new and in perfect order.

Oil Tanks.

Two—6 ft. x 24 ft., Bumptead heads, manhole, caulked inside and out, guaranteed under pressure 30 lbs. to sq. inch; new, never used.

Feed Water Heater.

200 H.P.—new, perfect condition.

Engine.

200 H.P.—new, Duplex engine, or two horizontal engines connected by one shaft—automatic cut-off and independent cut-off valves; condition first-class; specifications shown.

Boilers.

Two 100 H.P. horizontal tubular boilers, each 76 inches diameter, with 98 3½-inch tubes 16 feet long; new and thoroughly first-class material and workmanship used according to specifications.

The above, together with shafting, pulleys, belting, scales and miscellaneous tools, and main building (208 x 52 feet), modern and perfectly equipped, resting on an unexcelled factory site (567 x 367 feet), Hudson river and R.R. tracks at the doors, is offered—all or part—by the Receiver, at figures which make it an object to any buyer in this line.

The entire plant—as it stands—the site, buildings, machinery and equipment, is *ideal and up-to-date*, costing upwards of $60,000.00. It can be quickly converted into almost any sort of manufactory, malleable iron, or car-coupler works, etc., and the price—owing to peculiar conditions—makes it an object worthy of some correspondence, which is freely invited; or a visit to the premises—(still better).

If you ain't interested, perhaps some of your friends might be, and would thank you for the information, so cut this out, and bear the Receiver's address in mind:

HENRY L. SMITH, ***Receiver,***

50 State St., ALBANY, N. Y.

The Gold Car-Heating Company

Are equipping some trains on the Lehigh Valley road with their improved steam traps and couplers. The sales of the Gold straight-port steam coupler has averaged over 500 per day during the past thirty days. The brass-faced seat, which is a distinguishing feature of this steam coupler, is absolutely steam-tight, and is, therefore, popular with the traveling public as well as with the trainmen.

The equipping of the entire Broadway lines with their system of steam-heating is rapidly going forward, in addition to the application of same to 125 trailing cars on the Third Avenue line.

The installation of this system, as well as their electric system, is making drafts on their resources just at present that are hard to meet. Heretofore they have had their hands full, but the business has assumed proportions greater than in any preceding year.

"Punching and Shearing Machinery" is the name of Catalogue No. 18, recently published by the Long & Allstatter Co., Hamilton, O. This is a beautifully illustrated catalogue, and contains over eighty excellent wood-cuts, showing all the kinds of punching, forming and shearing machines made by the company. It will be found a remarkably useful reference to those who have purchases of such kind of machinery to make. It will also be useful in showing the great variety of purposes for which punching and forming machines are now employed. The catalogue will be sent to people who have anything to do with the purchasing of machinery, on application to the Long & Allstatter Co.

A new catalogue and price list has been published by the United States Metallic Packing Co., Philadelphia. This company are now handling quite a variety of appliance, used on locomotives and connected with the repair of locomotives. All the appliances handled are illustrated in the catalogue. Among the new ones, we observe they are handling the McIntosh improved automatic oil cellar and sight-feed oil cup, Saylor's portable drilling, reaming and tapping machine, the Gollmar bell ringer, and a variety of other useful articles. The catalogue will be found a useful reference for master mechanics and shopmen.

Riehle Brothers Testing Machine Company, Philadelphia, have a 100,000-pound automatic and autographic testing machine at the International Exposition, Atlanta, Ga. This machine forms a part of the Government Exhibit and is in the Minerals and Forestry Building, where anyone interested can see it in operation. Tests are being made upon this machine during the day, and it is attracting considerable attention.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(149) L. F. B., Wilkesbarre, Pa., writes:

Will you please tell me why the main parallel brasses of a mogul or ten-wheel engine are to be keyed up first, when putting up rods? *A.*—There is no reason apparent why this should be done, except in cases of peculiar construction of the rods, such as double keys, etc. In general practice it should make no difference where keying is commenced. 2. Why are the handles of angle cocks on brake pipes curved as they are? *A.*—Train pipe angle cocks have their handles curved so that when the cock is open the handle will stand parallel with the axis of pipe, and hug it as closely as possible, thus offering no inducement to a closure, either by accident or design.

(150) F. O., Brooklyn, N. Y., asks:

1. Under the most favorable conditions, what is the most perfect vacuum obtainable with the Eames vacuum brake ejector? *A.*—About 27 inches, which is equal to 13.25 pounds. 2. How long should it take for the pointer to drop to zero, say, in a four-car train, in order to be considered a good brake? *A.*—Careful tests were made to determine this point by Mr. R. B. Redding, master mechanic, Manhattan Ry. Co., and it was found that when the vacuum was destroyed by leaky pipes, to an extent of more than 25 inches in 15 seconds on a five-car train, that it was time to look after all joints in train pipes and diaphragms. This limit was found to be a practical one, as the braking power was not affected seriously when the pipes would retain the vacuum 15 seconds or more.

(151) W. R. P., Two Harbors, Minn., informs us that his engine had the draft rigging at the back of the tender injured in a collision so that the engine had to be backed to the terminal with caboose only. There is a long, descending grade into the terminal. While going down that grade attempts were made to work the injectors, but neither of them would operate. After some difficulty they were started after the engine stopped. The question is asked us, Why did these injectors refuse to work? *A.*—Questions similar to this one are frequently sent to us, and it ought to be apparent to the writers that we are not in a good position to answer them, because we are not able to examine the engine. There is a cause for every extraordinary action of any mechanism, but an examination of the machine is generally necessary to detect the source of trouble.

(152) J. C., Chicago, writes:

A valve has 1-inch outside lap, $\frac{3}{32}$-inch inside lap, and $\frac{1}{64}$-inch lead; has long travel, and the working cut-off is 4 inches. In overhauling, the eccentrics are set without lead, and port openings caught with a piece of tin. How does the valve now stand at beginning of stroke of piston, and what effect does the change have on the steam distribution? *A.*—Your statement that the eccentrics are set without lead answers the first question, for it is plain that if the engine has no lead the edge of valve and outer edge of steam port will be line and line at beginning of stroke. The distribution will not be affected to any serious extent by reducing the lead from $\frac{1}{64}$ to zero, but the tendency is in the direction of prolonging the expansion, and to change all other events of the stroke, making exhaust opening and closure later, but only to a slight degree.

(153) W. F. G., Eagle Grove, Ia., writes:

Kindly inform me what difference there

Dixon's Pure Flake Graphite

Gives free and easy action to valve motion.

Reverse lever can be held with one hand, even when full boiler-pressure is used.

The wear of link and valve motion is reduced to a minimum, and the hauling capacity and life of the locomotive greatly increased.

Engine will work two or three notches closer in cut-off, effecting a saving in fuel and water, and in cylinder and valve oil.

It prevents "squealing" of air pumps and "groaning" of cylinders.

Dixon's pure flake graphite WILL do all this and more, because it HAS done it whenever and wherever tried.

Send for samples and testimonials of experts and prove it for yourself.

JOS. DIXON CRUCIBLE CO.,

Jersey City, N. J.

is in the working parts of non-lifting and lifting injectors. *A.*—Injectors are widely varying in the arrangements of their working parts, and we will take some one make to answer the above. In the non-lifting injector there are no movable parts; it has no water valve or steam valve, the feed being handled by a lazy cock, and the starting and stopping is done by the throttle. The lifting injector has within itself a steam valve, a lifting valve and a water valve, all of which are manipulated in its operation, in addition to the throttle. The above is as we generally find them; there is no essential difference in the two types, except in the lifting jet which produces a partial vacuum to raise the water to injector; the steam valves, lazy cock, etc., are merely for convenience and not essential parts of the instrument.

(154) W. H. R., Cincinnati, O., asks:

1. Should not an engine with an Allen valve have $\frac{3}{16}$ to $\frac{1}{4}$ inch larger nozzle than those with the plain valve, as the port opening in mid gear increases from $\frac{3}{8}$ to $\frac{5}{8}$ or $\frac{3}{4}$ inch? *A.*—This matter is now before the Master Mechanics' Association for investigation, and the tests of the two types of valves will be made at some one of the testing plants. When this occurs, we shall give the results in our columns. 2. What difference will it make with one valve having $\frac{1}{16}$ inch lead, and the other $\frac{1}{32}$ inch lead? *A.*—The effect of advancing the eccentrics to obtain an increase of lead, is to hasten every other event in the stroke—that is, cut-off will take place sooner than before, exhaust will occur earlier, and the cylinder is therefore relieved of the back pressure always present with long points of cut-off, but against the gain from reduced back pressure will be found a loss due to the early exhaust opening, the effect of which is to reduce the expansion and thus get less effective work out of the steam for a given point of cut-off.

(155) W. O. B., Farley, Ia., writes:

Will you please inform me how the length of the link, or the distance between the centers of the eccentric-blade pin holes, is found for different link radii? *A.*—The length of a link, or the distance between centers of eccentric-rod pin holes, is not dependent on the radius of the link. The total length of the link arc—that is, the center of slot in which the block moves—is made up of the distance between centers of eccentric-rod pins, the length of link block, the slip of the block and the clearance between the ends of block and ends of link. The distance between centers of rod pins is usually taken at from 2 to 2.25 times the throw of eccentrics; thus if the throw is 5.5 inches (and this is common practice), the distance would be $2 \times 5.5 = 11$ inches, or $2.25 \times 5.5 = 12.375$ inches. The greater distance should be taken in preference to the other if there are no structural difficulties in the way, for the reason that the longer the link slot the less will be the slip of the block, because in separating these rod connections the influence of the rod not controlling the link is reduced to a minimum.

(156) L. E. K., Winslow, writes:

Will you kindly explain the practical and theoretical construction of the instrument known to machinists as the tram? *A.*—The trams used by machinists are both solid and adjustable; the solid tram is usually made of $\frac{3}{8}$-inch steel, with the ends bent at right angles to the body and sharpened to a point. This type of tram is used when "setting valves," one of the points being placed on a stationary part of the engine—say the running board—and the other point is used to mark the face of wheel, when finding the forward and back centers. Another and shorter tram of the same type is used by applying one end to the cylinder or steam chest, and marking on the valve-stem with the opposite point, to locate the position of valve. The adjustable tram consists of a beam, usually wood, upon which is a pair of sliding heads, iron or brass, to each of which is fitted a steel point. These heads are adjustable to any distance within the length of the beam. The facility with which the heads are moved, or made rigid at will, makes the instrument of wide application in transferring or comparing dimensions. Although its uses are legion, it is best known as an indispensable tool in tramming (comparing) the centers of axles, crank pins and rods.

(157) J. S., Quincy, Ill., writes:

We have six Roger engines on our road, and five of them will haul seventeen or eighteen loads; the five have a 62-inch wheel, and valves with $\frac{1}{16}$-inch lead. One of these engines has a 64-inch wheel, and valves with $\frac{1}{16}$-inch lead, and will not pull within four or five as many cars as the others. I claim that the two inches on the wheel would not make the difference in hauling capacity, and suggest that the steam gage be tested to see if she carries as much steam as her more powerful mates; and I would give her $\frac{1}{64}$ inch or less of lead, she would then handle the same rating as the others. Am I right? *A.*—Not altogether correct. The increased diameter of wheel has an influence on the tractive power of the engine that cannot be ignored, but your suggestion to reduce the lead may be a timely one, as it would slightly increase the capacity of the engine, for the reason that she would expand her steam longer. The following figures will show the comparative efficiency of the engines, in which we assume that all conditions are identical except wheel diameters. The size of cylinders has not been stated, but it is not important for a comparison, and we will take them to be 17x24 inches. The boiler pressure is assumed to be 140 pounds, and the mean effective pressure for full stroke taken at 90 per cent. of the boiler pressure, or 126 pounds. We then have from the above data the following values: Diameter of cylinder, 17 inches; stroke, 24 inches; mean effective pressure, 126 pounds, and diameter of drivers, 62 and 64 inches, respectively. If, now, by the formula, we square the diameter of cylinder and multiply the result by the mean effective pressure, and that product by the stroke, and then divide the whole by the diameter of wheels, all in inches, we have the tractive power of the engine in pounds. Numerically expressed, the formula would read $17 \times 17 \times 126 \times 24 \div 62 = 14{,}095$ pounds, and this is also equal to the pull on the drawbar. The tractive power for the engine that does not fill the requirements is found to be equal to $17 \times 17 \times 126 \times 24 \div 64 = 13{,}655$ pounds; now, dividing both of these values by 8, which we will take as the resistance in pounds per ton, we have 1,762 tons for the first engine and 1,707 tons for the weaker one; a difference of 55 tons or about two average loads. From these figures we find just what the difference in wheel diameters is responsible for; showing as they do that the lack of hauling power is not altogether due to this cause. The rational procedure in cases of this kind is to *know* that the boiler pressures are equal, and if then the results are not what they should be, an indicator should be applied to the cylinders to locate and rectify any trouble existing there. When the engines are working at their best, they will be found to closely agree with the figures herewith presented.

$1,500 Lathe Given Away.

On March 1, 1896, the Lodge & Davis Machine Tool Co. will present to the technical or mechanical school receiving the greatest number of votes, a magnificent nickel and gold-plated 16-inch swing tool-room lathe.

This lathe was exhibited by them at the World's Fair in Chicago, and was pronounced by the judges and visitors to be the finest piece of machinery displayed in Machinery Hall.

The entire lathe is nickel-plated, with the exception of the bolts, which are gold-plated. The inside of the bed is finished in white enamel.

The cabinets are provided with shelves, which are lined with cardinal silk plush.

The cost of this lathe as regularly built is $450, and the extra work in preparing, plating, etc., amounted to $1,100.

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Votes conforming only to the following conditions will be registered:

1. Full name and address must be given.
2. Give name of technical school preferred.
3. No duplicate votes will be registered.
4. No votes will be registered that are received after 12 noon of March 1, 1896.

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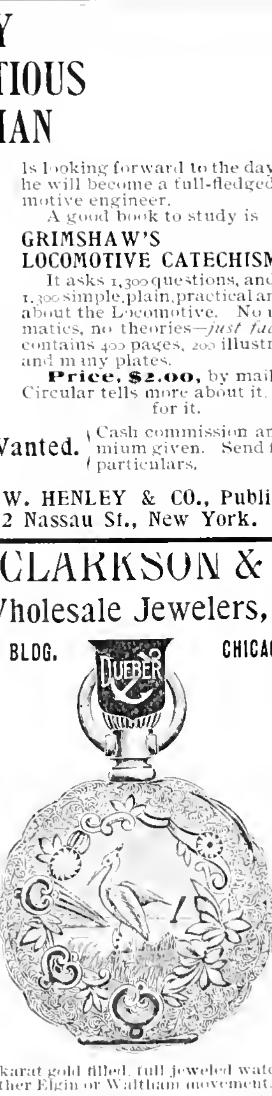

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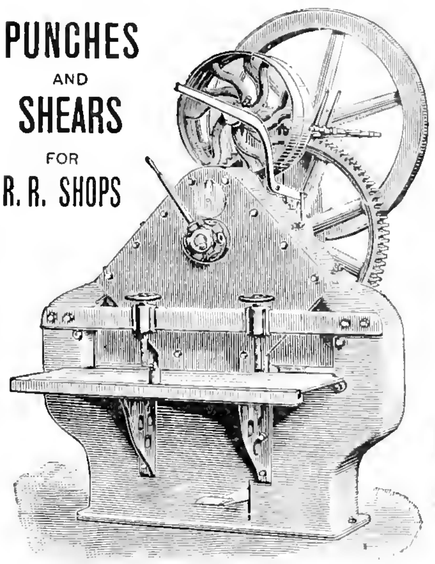

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THIS WRENCH, if kept sharp, will grip high on the pipe, and you can screw a pipe so tight that it will open a malleable fitting and strip the thread, WITHOUT CRUSHING OR CUTTING THE PIPE.

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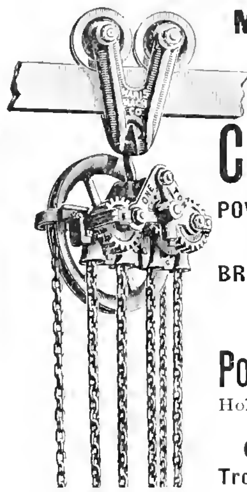

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Classified Index of Our Advertisers.

Continued on page 785.

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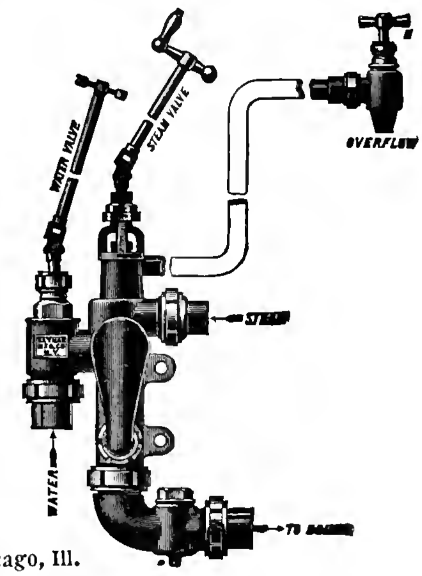

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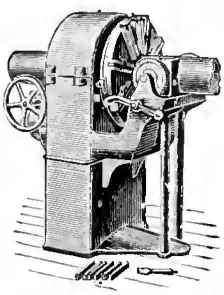

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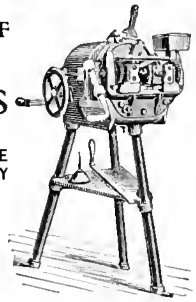

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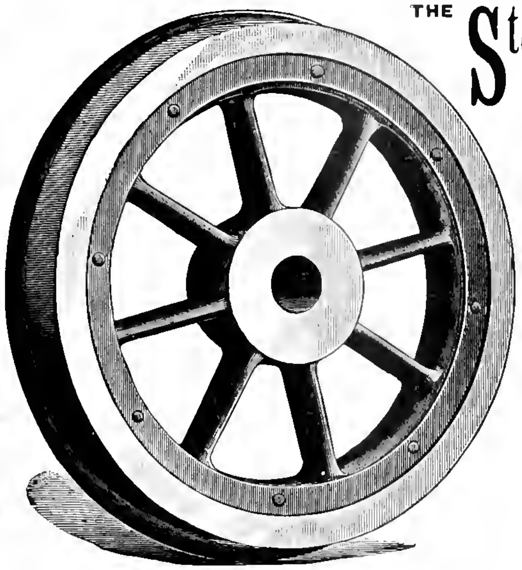

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Locomotive Clocks.
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Locomotive Fire Kindlers.
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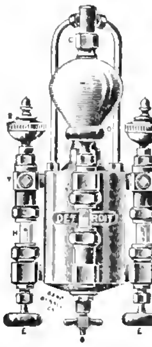

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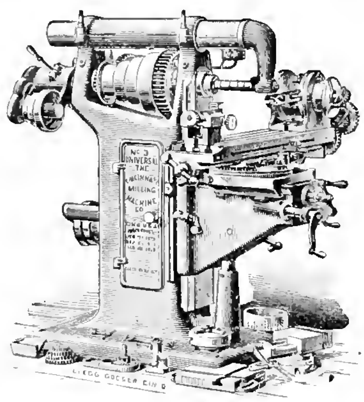

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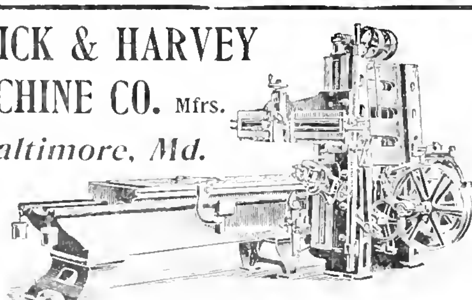

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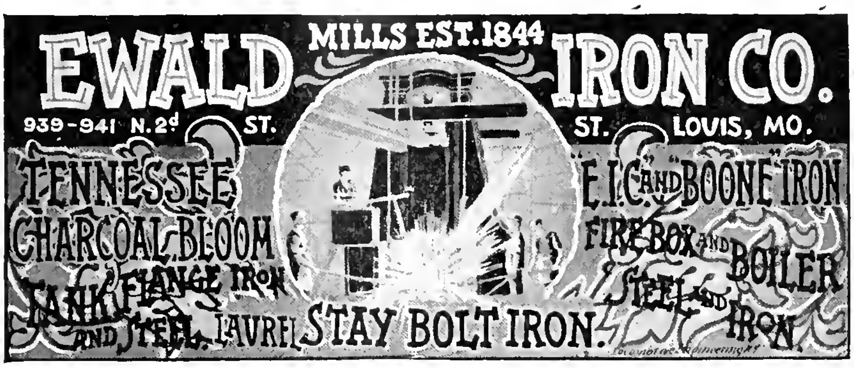

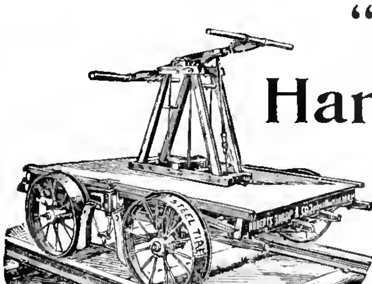

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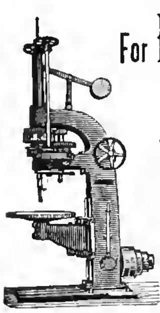

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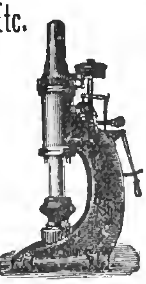

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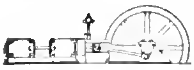

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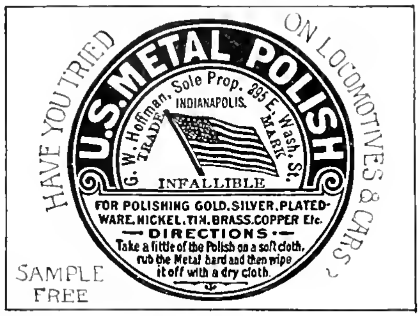

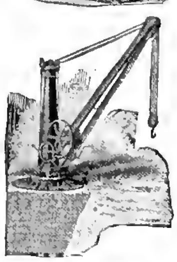

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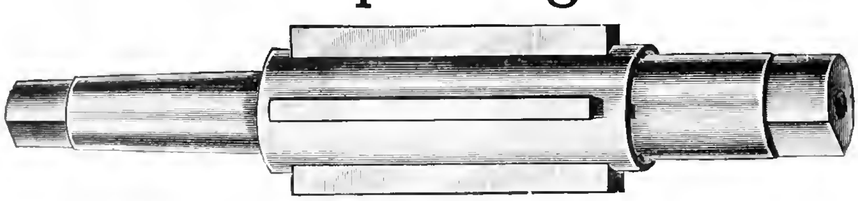

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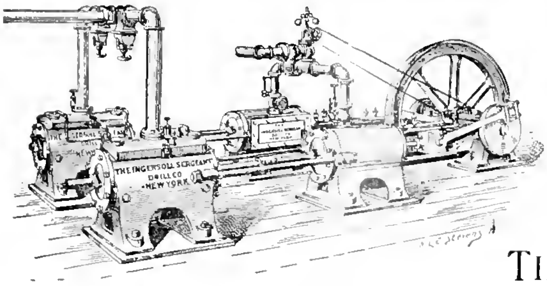

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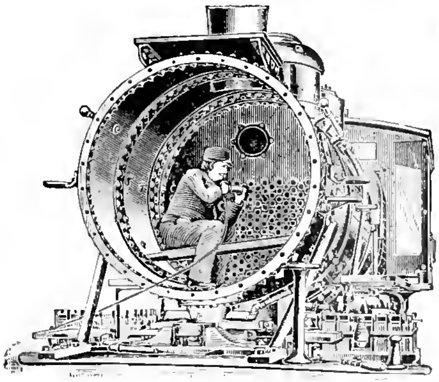

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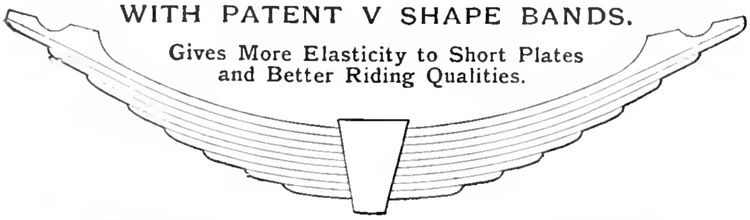

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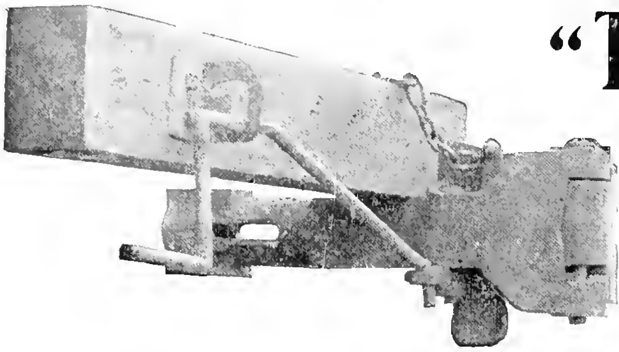

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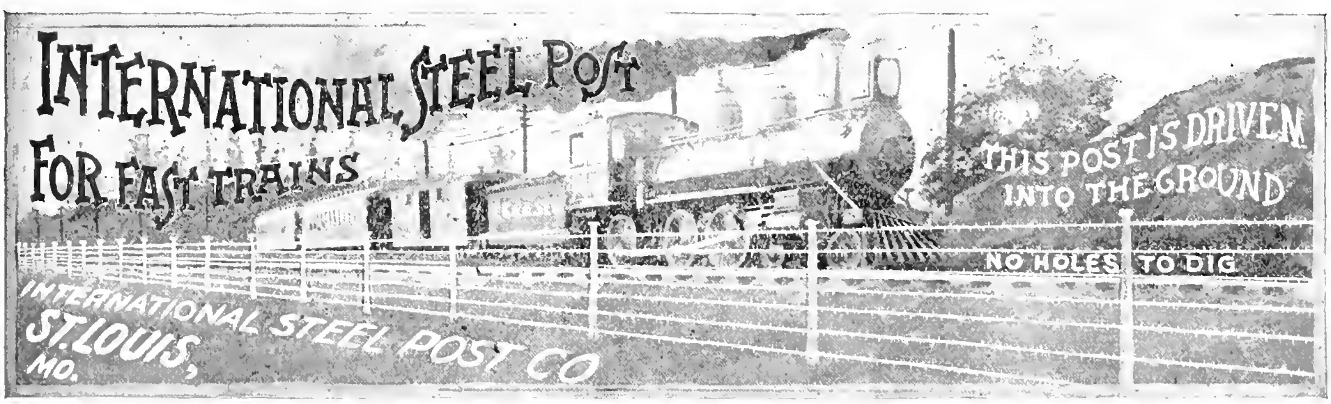

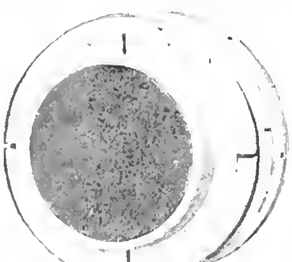

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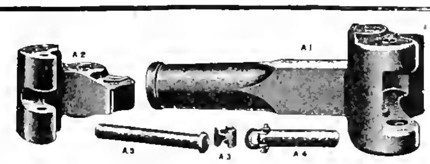

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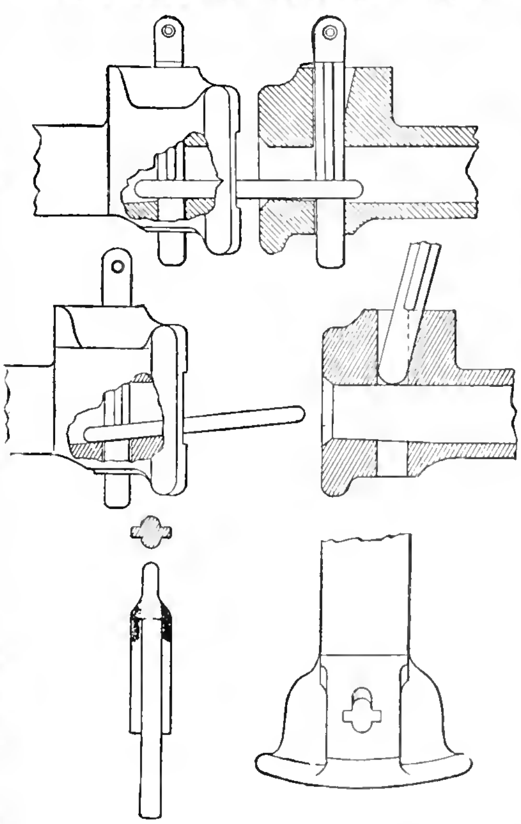

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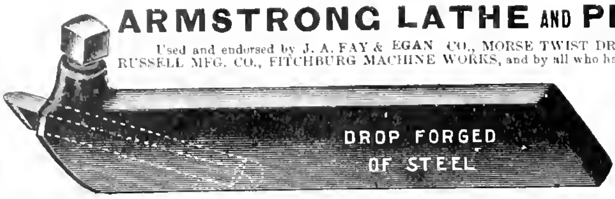

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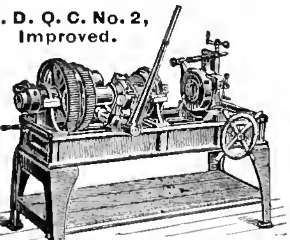

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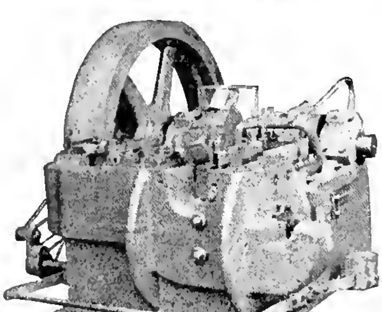

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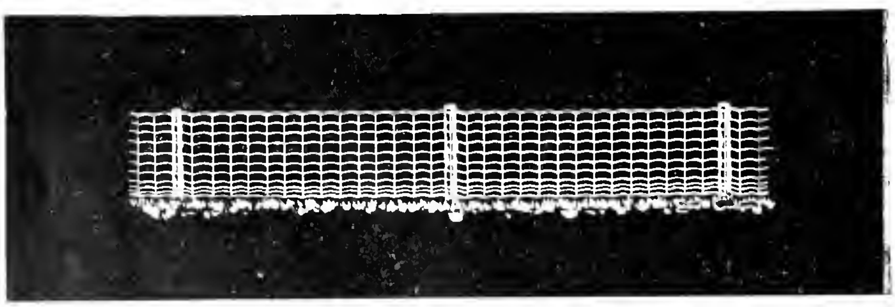

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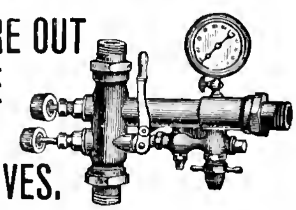

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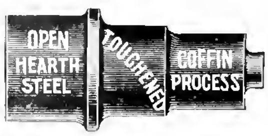

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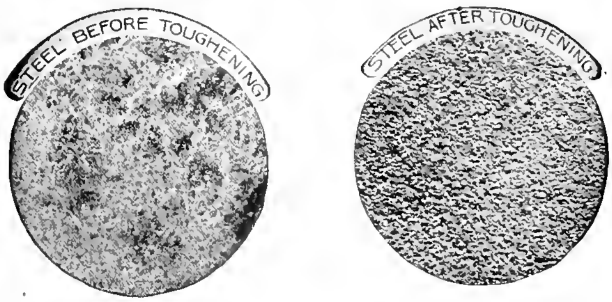

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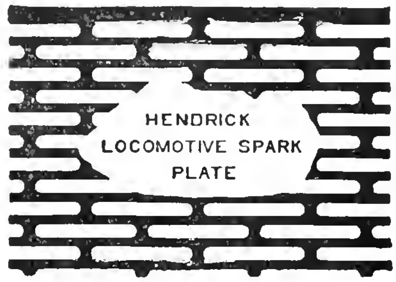

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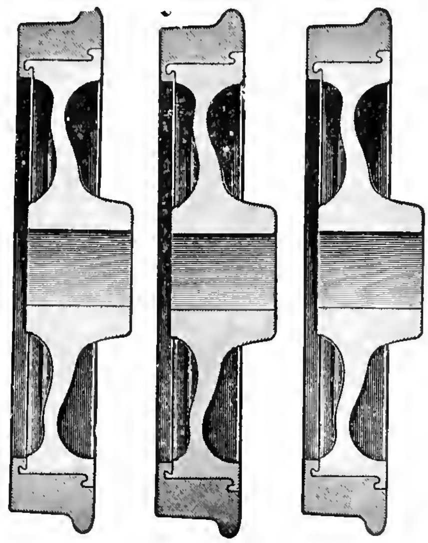

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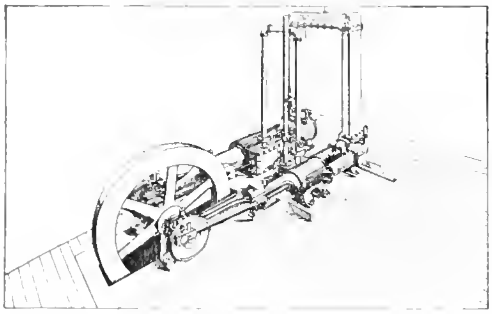

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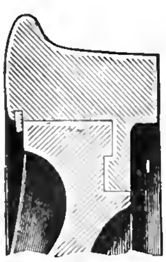

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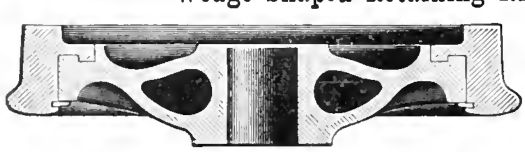

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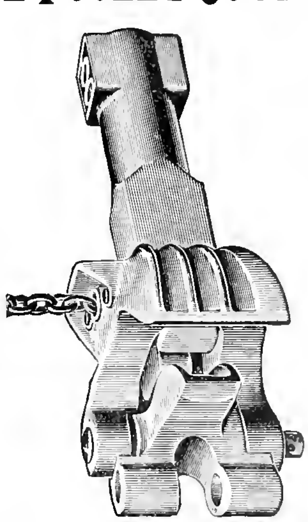

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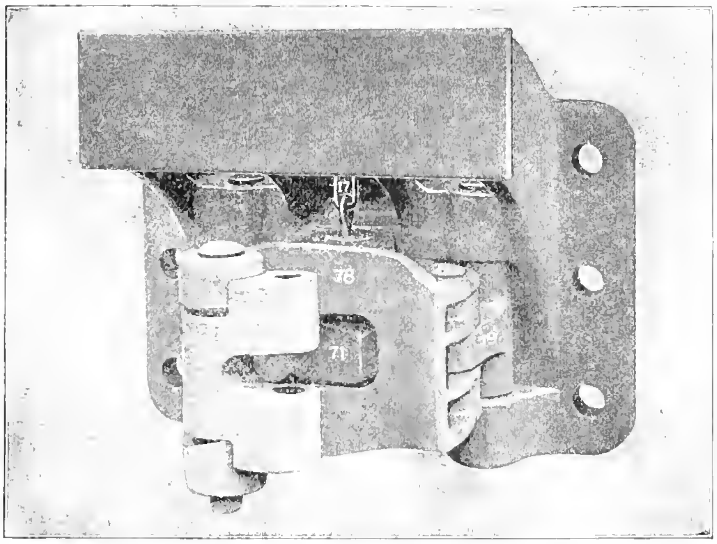

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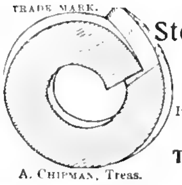

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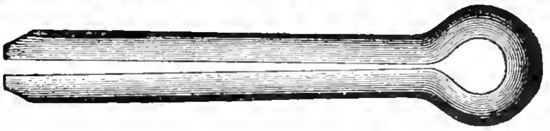

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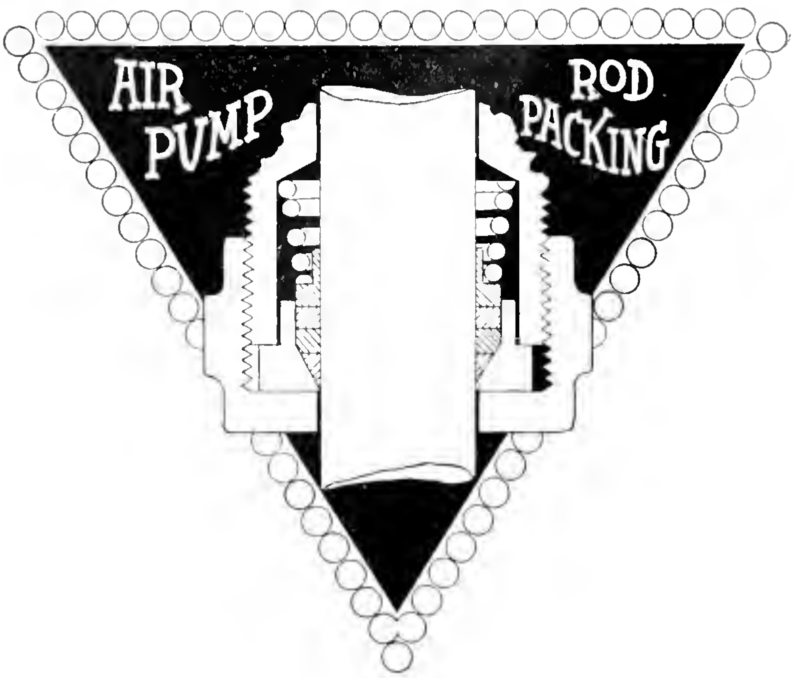

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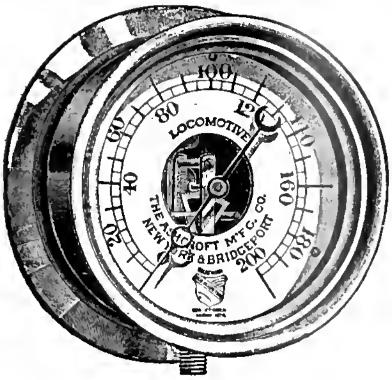

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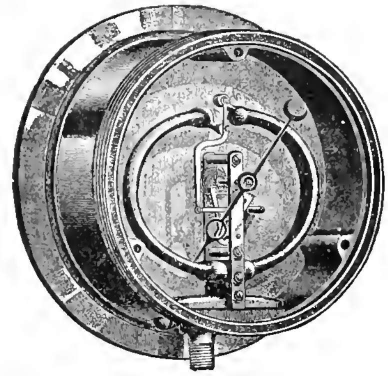

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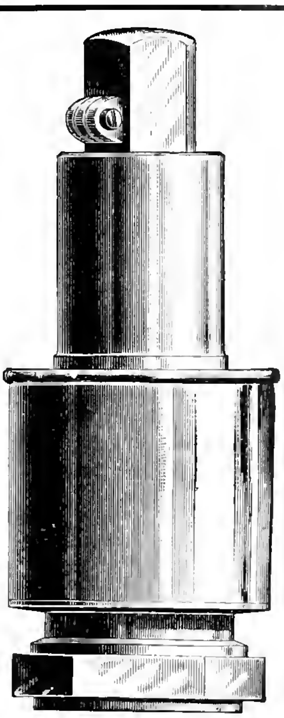

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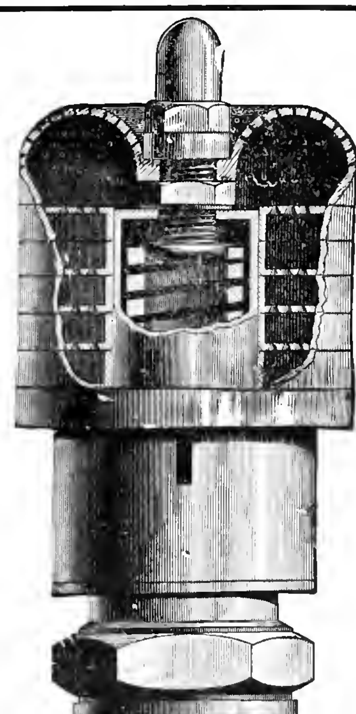

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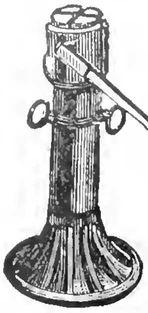
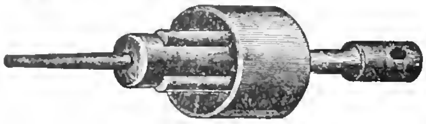

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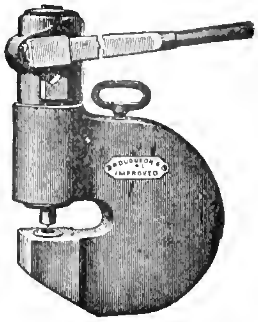

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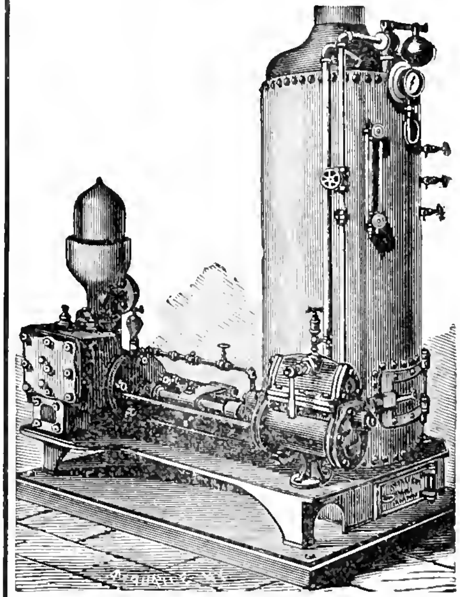

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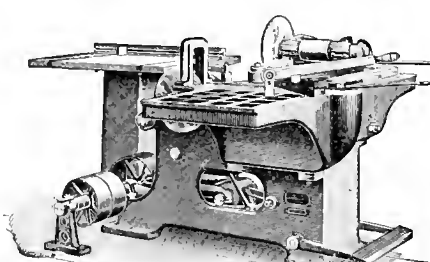

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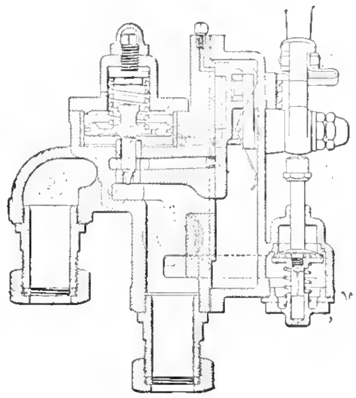

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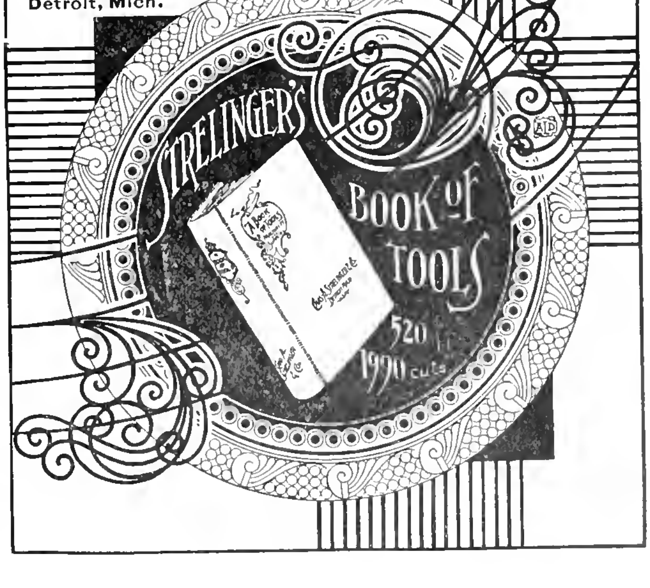

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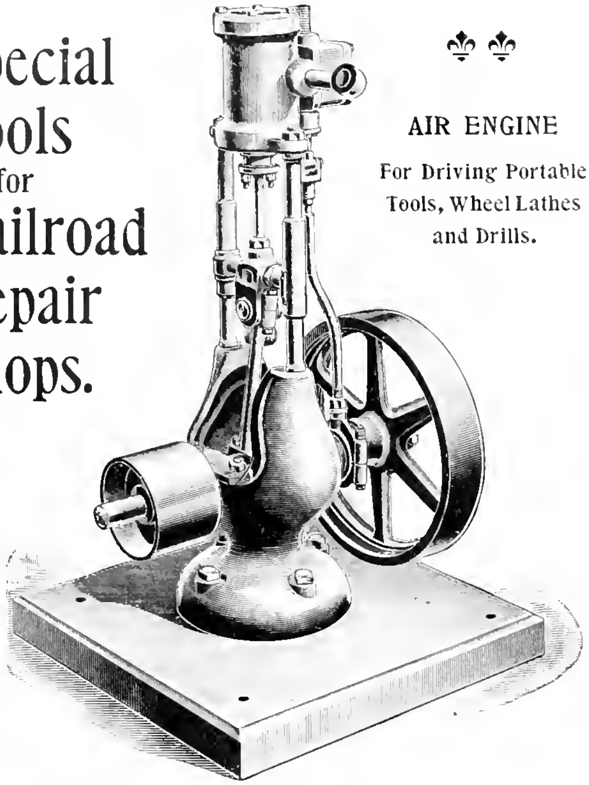

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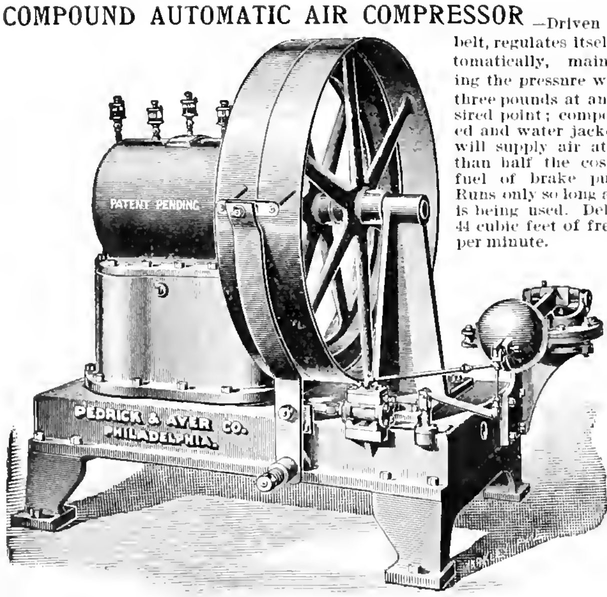

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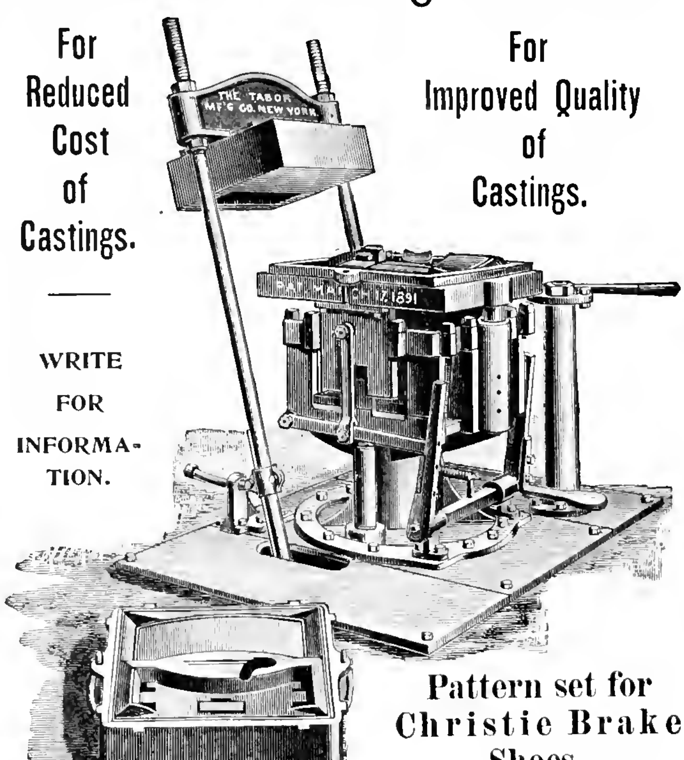

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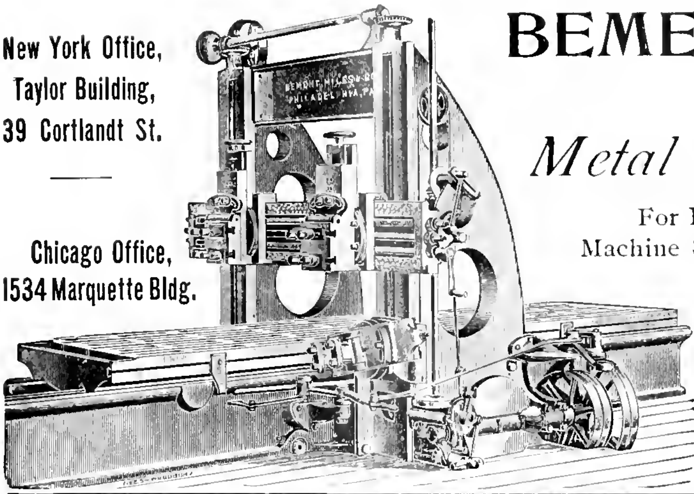

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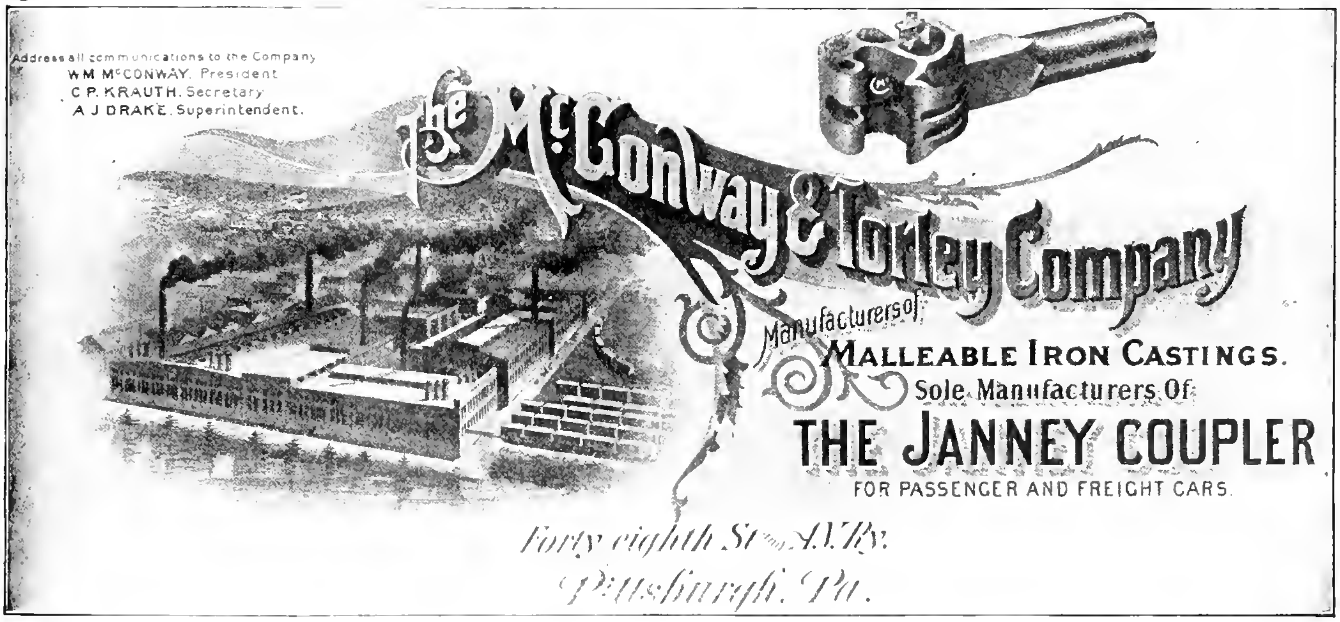

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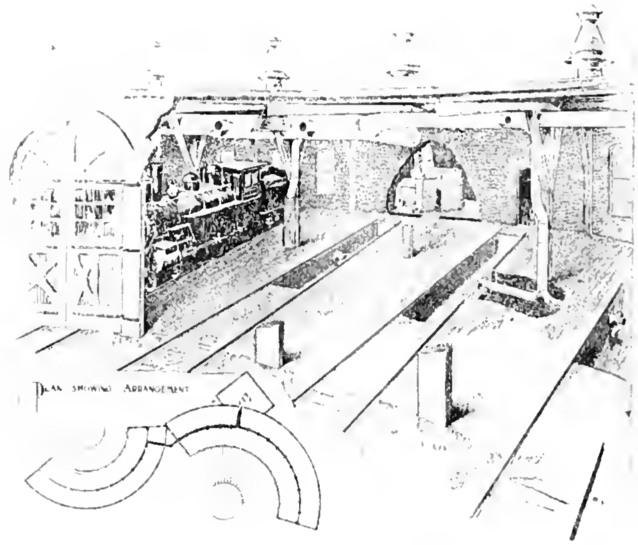

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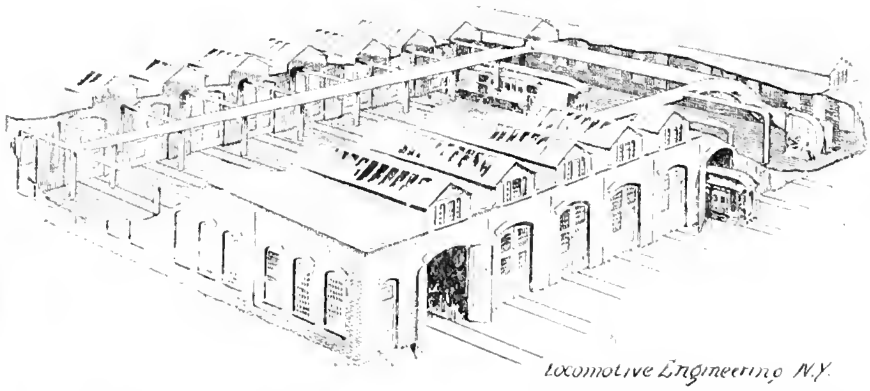

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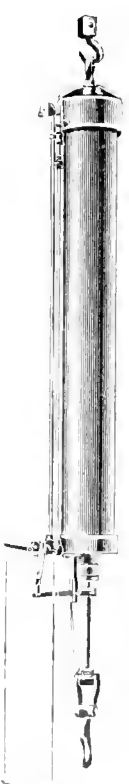

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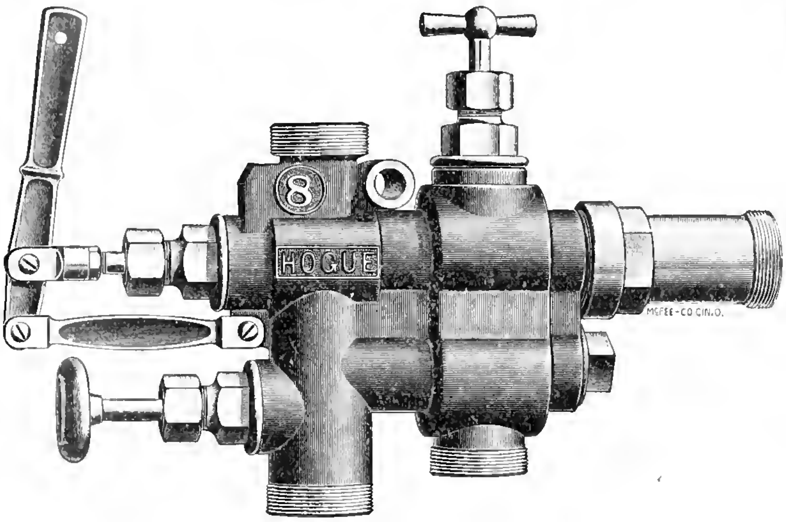

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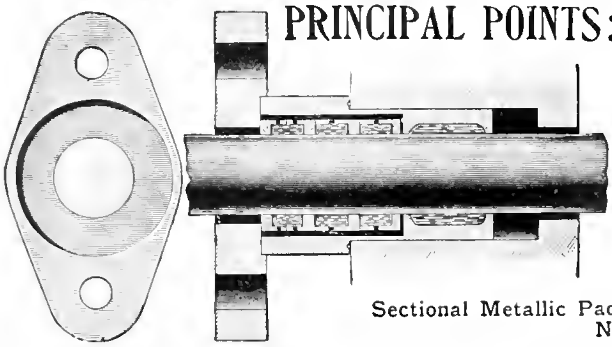

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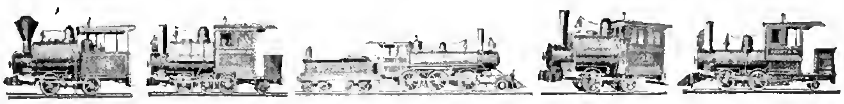

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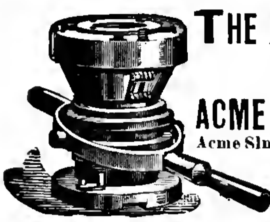

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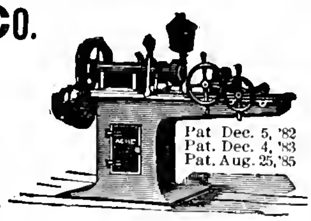

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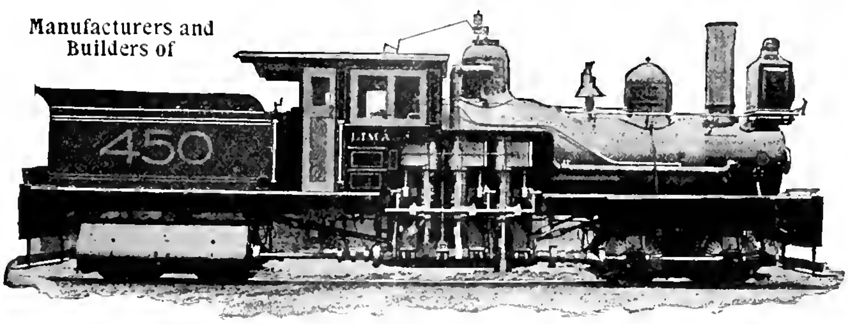

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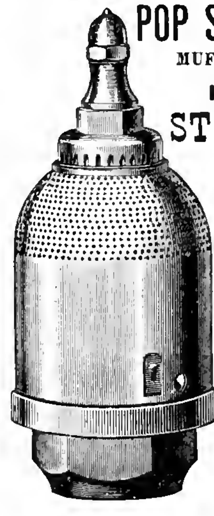

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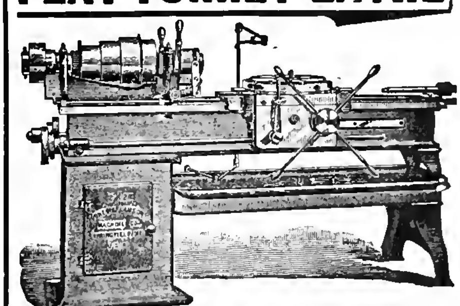

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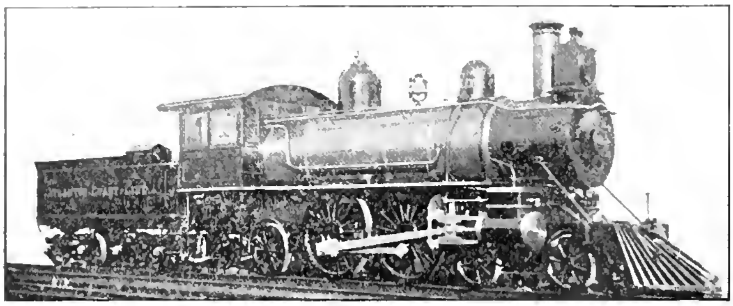

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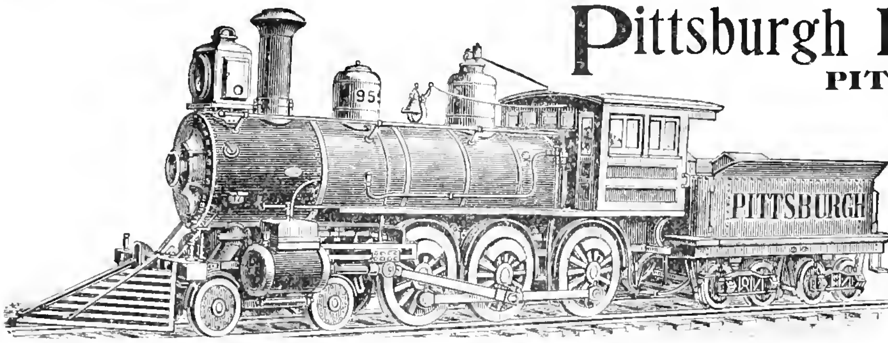

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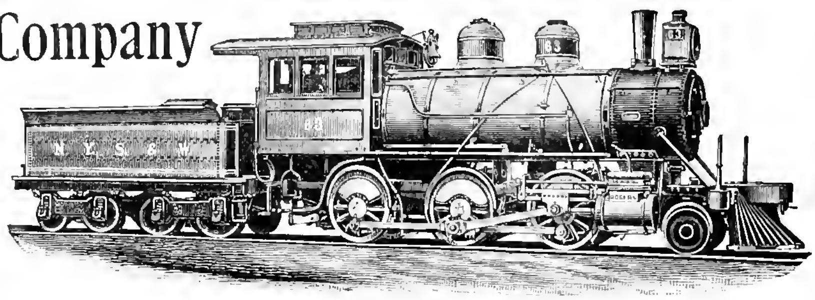

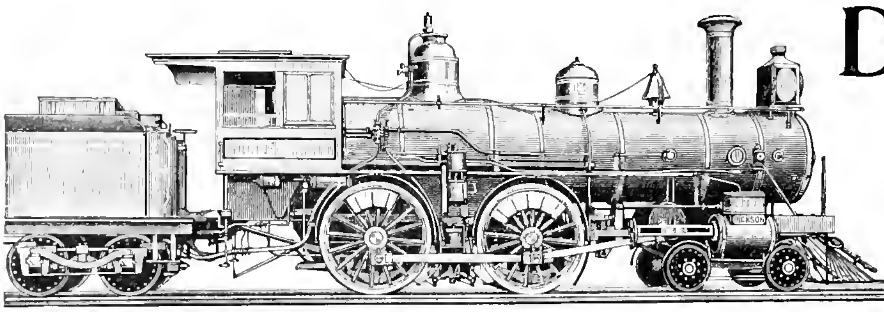

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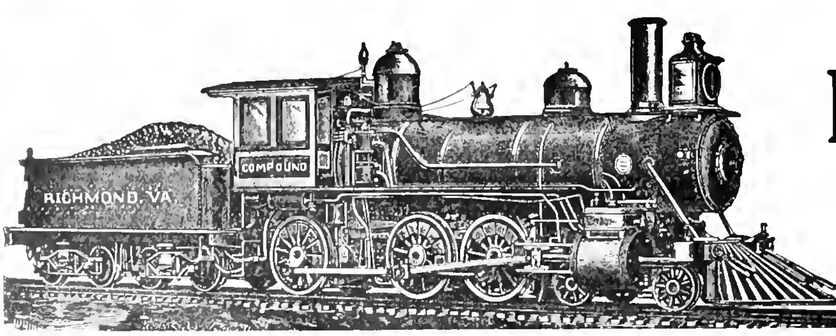

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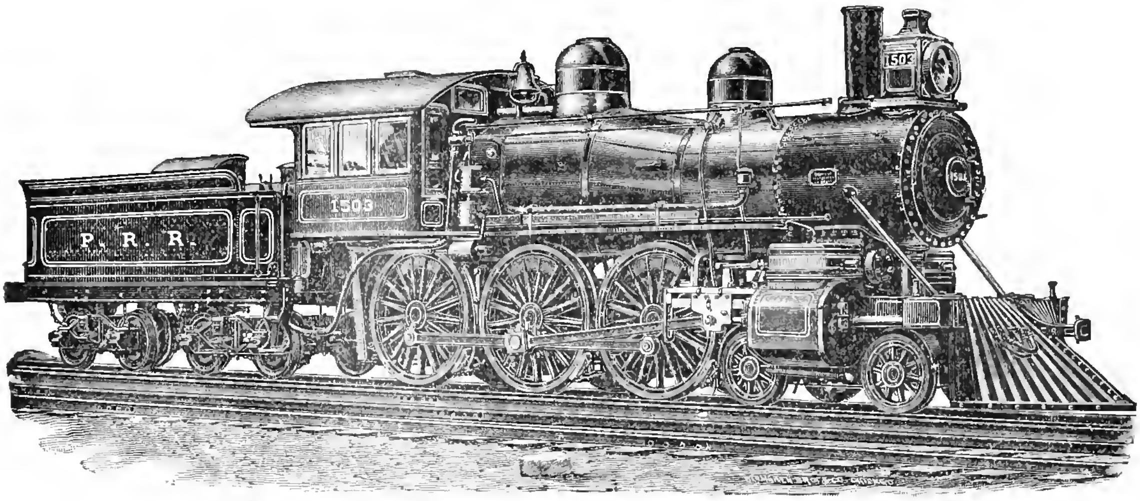

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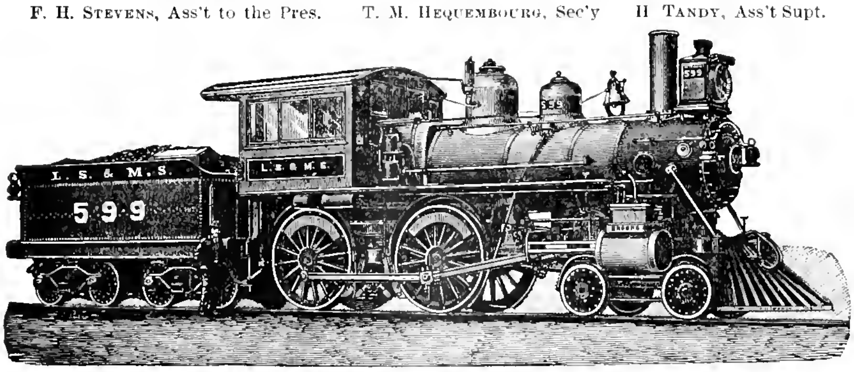

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